UMTRA-DOE/AL 050510
.GRN0

United States Department of Energy

Remedial Action Plan and Final Design for Stabilization of the Inactive Uranium Mill Tailings At Green River, Utah

Final

Volume IIA – Appendix D: Supplement, Site Characterization

Appendix E: Groundwater Protection Strategy

Appendix B of the Cooperative Agreement No. DE-FC04-81AL16257

December 1989

Uranium Mill Tailings Remedial Action Project UMTRAP

NOTE: This site characterization description of groundwater hydrology (Section D.5) contains many changes from the previous version published in January 1989 in Volume IIA of the Green River RAP. The January 1989 version of Section D.5 should be considered obsolete and is superseded by this document. Other sections of Appendix D have not changed since the February 1988 RAP was issued with the exception of Section D.4. Additional geotechnical data were reported in the January 1989 Appendix D Supplement, Site Characterization, Section D.4.

A.1 INTRODUCTION

This appendix is intended to identify and describe the permits, licenses, and approvals that are likely to be required for the proposed action based upon the site design (see Section 4.0 of the text). Other permits, licenses, and approvals may be required for activities beyond the scope of the Remedial Action Plan (RAP) or due to modification of the conceptual design.

Procedures for preparing permit, license, or approval applications and agency review processes are outlined in the following sections. The principal technical and supervisory personnel at the regulatory agencies are listed as well. The Remedial Action Contractor (RAC) should consider this appendix to be an introduction to the permitting process while details must be obtained from the regulatory agencies. Applications must be submitted to Federal, state, and local agencies depending on the type of permit, license, or approval sought.

A tentative schedule for regulatory compliance activities (Figure A.1.1) is included for initial planning purposes. Figure A.1.2 illustrates the regulatory compliance matrix. The RAC should sequence the preparation and filing of applications so that approvals will be received in a timely manner without causing delay to construction activities. Environmental Services personnel from the Technical Assistance Contractor (TAC) will provide additional assistance as needed.

FIGURE A.1.1 REGULATORY COMPLIANCE SCHEDULE, GREEN RIVER, UTAH

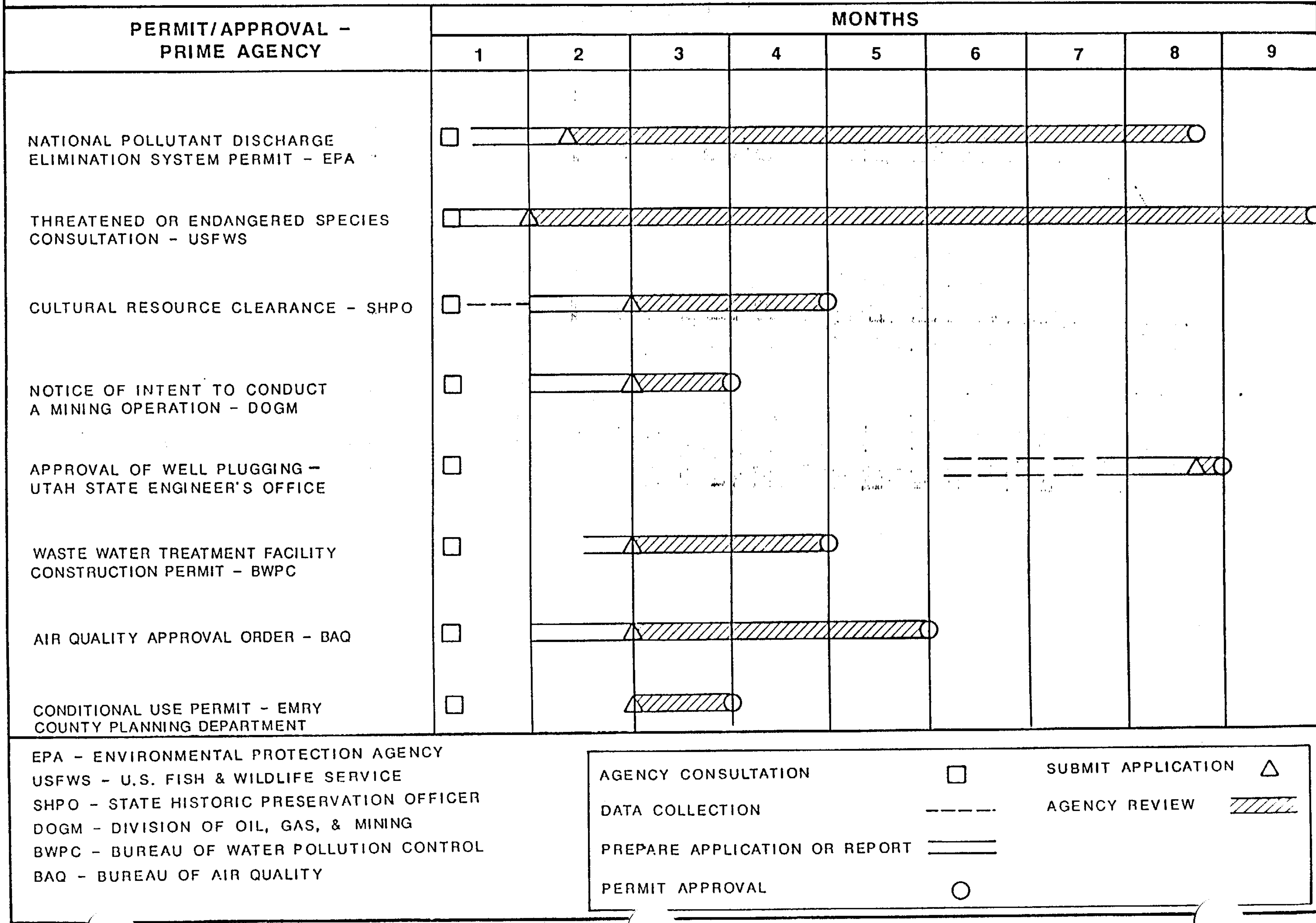


FIGURE A.1.2

REGULATORY COMPLIANCE COORDINATION

GREEN RIVER UTAH

REGULATORY AGENCY

PERMIT OR APPROVAL	UTAH DEPARTMENT OF HEALTH	U.S. F & WS	UTAH SHPO	UTAH STATE ENGINEER'S OFFICE	UTAH DIV. OF OIL, GAS & MINING	EMRY CO. PLANNING DEPT.
NPDES PERMIT	L					
THREATENED & ENDANGERED SPECIES CONSULTATION		L				
CULTURAL RESOURCES CLEARANCE			L			
APPROVAL OF WELL PLUGGING				L		
NOTICE OF INTENT TO MINE					L	
WASTE WATER TREATMENT CONSTRUCTION PERMIT		L				
AIR QUALITY APPROVAL ORDER		L				
CONDITIONAL USE PERMIT						L

L - LEAD AGENCY

PERMIT: NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM (NPDES) PERMIT

LEGAL CITATION: Clean Water Act of 1977; 40 CFR 125

AGENCY/CONTACT: Utah State Department of Health
Division of Environmental Health
Bureau of Water Pollution Control
P.O. Box 16690
Salt Lake, UT 84116-0690
ATTN: Calvin Sedweks, Executive Secretary (801) 538-6146
Steven McNeal, Environmental Engineer

PROCEDURE: This permit applies to all operations discharging to waters of the United States from a point source. Application is made by filing completed U.S. Environmental Protection Agency (EPA) Forms 1 and 2C under the EPA Consolidated Permits Program. Information required on Form 1 includes:

(1) Name, mailing address, and location of the facility.

(2) Facility contact.

(3) Standard industrial classification code for the facility.

(4) Existing Federal, state, or local permits.

(5) Map covering an area extending at least one mile beyond the facility property boundaries. The map should be based on a 7.5-minute U.S. Geological Survey quadrangle map.

(6) Description of the nature of the facility.

Form 2C requires the following information:

(1) Location, by latitude and longitude, and number designation of each effluent outfall.

(2) Name of receiving water for each outfall.

(3) Schematic flow diagram indicating sources of water, operations contributing wastewater for the effluent water balance, and treatment processes for each waste stream.

(4) List of each operation, average flow, and treatment related to each outfall.

(5) Description of the variation and frequency of water flow.

(6) Explanation of any Federal, state, or local implementation schedule for construction or improvement of wastewater treatment or other environmental programs.

(7) Influent and effluent characteristics:
- o Pollutants present.
- o Source of pollutants.
- o Concentration of pollutants.
- o Temperature of effluent.
- o Flow of effluent.
- o pH of effluent.
- o Total mass of pollutants discharged in a specified time interval.

<u>SPECIAL CONSIDERATIONS</u>: Form C may be used as an alternative to Form 2C in the application. The conceptual design specifies that a zero discharge retention pond will be used to receive contaminated water. For this type of facility, the main purpose in obtaining an NPDES permit is to limit the liability of the operator for discharges that may result from a very large precipitation event or other unanticipated event. The EPA and state officials encourage operators to obtain a permit for a zero discharge facility. Prohibitions of a discharge permit include, but are not limited to, the following:

(1) No discharge is allowed that will violate state, regional, or local land use plans unless all requirements and conditions of applicable Federal and state statutes and regulations are met or will be met according to a schedule of compliance. Similarly, no discharge is permitted that by itself or in combination with other pollutants will result in pollution of the receiving waters in excess of standards, unless the permit contains effluent limitations and a schedule of compliance with water quality requirements.

(2) Limits of radiological wastes that may be discharged are determined by state water quality standards.

(3) No discharge from a point source that is in conflict with an established water quality management plan promulgated under Sections 201, 208, 209, and 303(e) of the Federal Water Pollution Control Act of 1972 and the Clean Water Act of 1977 is permitted unless the discharge permit contains limitations and a schedule of compliance approved by the EPA.

The frequency of measuring, monitoring, and reporting is dependent on specific discharges.

<u>SCHEDULE</u>: The State of Utah will assume NPDES primary from the EPA in Febuary, 1987. An applicant is to apply for a permit at least 180 days in advance of the date the discharge is to begin. In some cases, the state may determine that a site visit or additional information are necessary. In such a case, the applicant has 60 days to reply.

PERMIT: THREATENED OR ENDANGERED SPECIES CONSULTATION PROCESS

LEGAL CITATION: Endangered Species Act of 1973, Section 7, 16 USC 1531, et seq.

AGENCY/CONTACT: U.S. Fish and Wildlife Service
Endangered Species Office
2078 Administration Building
1745 West 1700 South
Salt Lake City, Utah 84138
ATTN: Robert Ruesink, Field Supervisor (801) 524-4430

PROCEDURE: A Federal agency must ensure that any action authorized, funded, or implemented by the agency is not likely to jeopardize the continued existence of any threatened or endangered (T&E) species or its critical habitat. The responsible Federal agency must consult with the U.S. Fish and Wildlife Service (USFWS) to determine what effect, if any, the proposed action might have on any T&E species.

In most cases, a letter is sent by the Federal agency to the USFWS outlining the proposed action. If the USFWS determines that no T&E species would be adversely affected by the action, the USFWS responds stating their finding and that no further compliance measures are necessary. If the USFWS identifies any T&E species that may be affected, the Federal agency is required to prepare a biological assessment considering the species identified by the USFWS, determine any impacts, and recommend appropriate mitigation measures. The Federal agency will issue a formal opinion of "may effect" or "no effect."

SPECIAL CONSIDERATIONS: No listed or proposed threatened or endangered plant or wildlife species are known to occur at the Green River tailings and borrow sites. However, the bald eagle, peregrine falcon, and Colorado squawfish may occur near the sites. The remedial action activities are not expected to affect these species. The Environmental Assessment will serve as the biological assessment for consultation with the USFWS.

SCHEDULE: After obtaining the list of T&E species from the USFWS, the Federal agency has 180 days or another mutually agreeable time period to complete a biological assessment. The Federal agency requests a Section 7 consultation, and the USFWS is required to issue a biological opinion within 90 days.

PERMIT: CULTURAL RESOURCE CLEARANCE

LEGAL CITATION: Historic Preservation Act of 1966, 16 USC 470; Executive Order 11593; and 36 CFR 800

AGENCY/CONTACT: State Historic Preservation Office
Utah State Historical Society
300 Rio Grande
Salt Lake City, Utah 84101
ATTN: Dr. Melvin T. Smith, State Historic Preservation Officer (801) 533-5755

PROCEDURE: All Federal agencies are required to inventory archaeological and historical resources affected by their undertakings and to protect and, when necessary, recover significant resources. Prior to initiating surface disturbing activities, cultural resource clearance should be obtained from the State Historic Preservation Officer (SHPO). The organization sponsoring the activity should contract with an approved archaeologist to conduct a site survey. If a survey of the area has been completed previously, a new survey may not be required. The survey report should be sent to the SHPO.

SPECIAL CONSIDERATIONS: The discovery of archaeological sites during the course of Federally assisted, permitted, funded, or licensed construction or land alteration must be reported to the Interagency Archaeological Service (IAS) of the U.S. Department of the Interior. If a previously undiscovered site is revealed during the course of construction, the official in charge should halt construction and request an on-site assessment by the IAS. The IAS will respond within 48 hours with a professional assessment of the significance of the site. In consultation with agency officials, the IAS representative makes an on-site decision for (a) salvage, (b) burial, or (c) destruction of the site. The main office of IAS can be contacted at (202) 272-3750. For more information, see 36 CFR 66.

The archaeological survey of the area around the processing site revealed two historic trash dumps and no archaeological sites. The two historic sites are ineligible to the National Register of Historic Places. The borrow sites have not been surveyed; undisturbed areas should be surveyed prior to surface disturbance.

SCHEDULE: The SHPO review of archaeological reports involves one to three months.

ACTIVITY: NOTICE OF INTENT TO CONDUCT A MINING OPERATION

LEGAL CITATION: Utah Code Annotated; Mined Land Reclamation Act of 1975, Ammended 1982

AGENCY/CONTACT: Utah State Division of Oil, Gas, and Mining
No. 3 Triad Center
Suite 350
Salt Lake City, Utah 84180
ATTN: Lowell Brakston, Administrator, (801) 538-5340
Mined Land Reclamation Program
Frank Files, Reclamation Engineer

PROCEDURE: The mining of the borrow sources will require approval by the State of Utah. Application is made by providing information on form MR-1. Information to be provided consists of the following:

(1) Mine name and operator.
(2) Name and address of applicant.
(3) Location of mine.
(4) Name and address of surface owner.
(5) Name and address of mineral owner.
(6) Mine plans and maps including contour features, locations of disposal and stockpile areas, drainage patterns of land affected, highways and facilities near site, and known drill holes.
(7) Amount of acreage to be disturbed - including access and haul routes.
(8) Description of mining sequence.
(9) Estimated duration of mining operation.
(10) Construction and maintenance of access roads.
(11) Prior land use.
(12) Description of soils and their stockpiling.
(13) Description of methods to minimize hazards to public safety.
(14) Grading and revegetation.
(15) Description of impoundments.
(16) Reclamation schedule.

SPECIAL CONSIDERATIONS: The state will simplify the process in this case. No bonding would be required and there is no application fee. They will place a few stipulations on the permit, such as leaving 2:1 slopes and revegetation of the mined areas.

SCHEDULE: 30 days.

ACTIVITY: WASTEWATER TREATMENT FACILITY CONSTRUCTION PERMIT

LEGAL CITATION: Utah Code Annotated 26-15-45 and 73-14-1 through 13. Wastewater Disposal Regulation, Parts I through VII.

AGENCY/CONTACT: Utah State Department of Health
Division of Environmental Health
Bureau of Water Pollution Control
P.O. Box 16690
Salt Lake City, UT 84116-0690
ATTN: Steven McNeal (801) 538-6146
Environmental Engineer

PROCEDURE: The Construction Permit is required prior to construction of wastewater treatment works, or the discharge of wastewater. Application is made by submitting complete construction plans and specifications in the form of an engineer's report which shall include:

(1) A brief description of the project.

(2) A description of the location and topography of the site.

(3) Volume and character of wastewater flow in various seasons.

(4) A brief description of the extent of existing and proposed sewers and sewage treatment facilities in the area.

(5) A description of the treatment plant site, including:
- Distances to residences and commercial deveopment areas.
- Topography and layout of proposed facilities.
- Flood potential.

(6) Location of wells and surface waters within one-half mile. Results of soil boring to determine surface and subsurface characteristics of any proposed pond areas.

(7) A discussion of the facility design including reasons for the selection of the treatment process.

The Utah Water Pollution Control Committee considers the recommendation of the Bureau and approves or denies the Construction Permit application.

SPECIAL CONSIDERATIONS: The regulations are directed primarily at sewage treatment facilities, however, the regulations also apply to industrial wastewater treatment. Part II of the regulations contains "Standards of Quality for Waters of the State" and Part III contains specifications for "Sewers and Waste-Water Treatment Works."

SCHEDULE: An approved permit is required prior to construction. A 30- to 60-day review time is needed for permit approval. No public notice is required.

ACTIVITY: AIR QUALITY APPROVAL ORDER

LEGAL CITATION: Utah Code Annotated 26-15-5 and 26-24-5, 1953 as amended. Utah Air Conservation Regulations (UACR) Part III, Section 3.1

AGENCY/CONTACT: Utah State Department of Health
Division of Environmental Health
Bureau of Air Quality
P.O. Box 16690
Salt Lake City, UT 84116-0690
ATTN: Brent Bradford, Director (801) 538-6108
Montie Keller, Chief
Compliance Division

PROCEDURE: A notice of intent to construct, modify, or relocate an installation is submitted to the Executive Secretary of the Utah Air Pollution Control Board. The notice of intent is based upon the following information:

(1) Description and nature of the process(es) and materials handling system(s) including a plot plan and process flow chart(s) with a narrative walk-through of the process(es).

(2) Quantities and types of raw materials used (including fuels) and production output of each process (normal and maximum pounds/yr). Include chemical composition, particle size distribution, formula, and moisture content of the materials.

(3) Chemical composition and physical characteristics of each effluent/exhaust stream (e.g., particle size distribution, formula, moisture content, molecular weight).

(4) Effluent/exhaust loading before (if known or estimated) and after control equipment/procedure (e.g., grains/dscf, lbs/hr, ppm, grams/sec). Must address all pollutants including those from fuel combustion operations and from fugitive sources. Special emphasis must be given to TSP, SO_2, NO_x, CO, O_3, and HC (especially VOC).

(5) Operating schedule (hr/day/yr) for each individual pollution point/area. In the absence of a schedule, the state will assume 365 days/yr, 24 hr/day.

(6) Known or estimated construction/installation/modification schedule (start and end dates).

(7) Since best available control technology (BACT) is required on all sized sources throughout the state and for all types of air emissions, including fugitives, provide the rationale for the selection of type and efficiency of control equipment and/or operational procedures used to minimize emissions. For visible emissions, give expected/guaranteed opacities.

(8) Calculations of emissions (normal and maximum/hr or yr) showing emission factors used with rationale and technical justification (state reference). For vehicular emissions include combustion of fuels and haul/access/operational area fugitive dusts and vehicle miles traveled. For fugitive sources estimate the height of source/height of pile, area of source and/or dimensions; for roadways give average moisture and silt content, length, type of surface, and location/orientation.

(9) Type of compliance stack/exhaust testing to be done by applicant to show compliance. List/discuss the test points/locations and test methods selected.

After reviewing the notice of intent, the Executive Secretary issues an approval order or disapproval order. An approval order authorizes the commencement of construction.

SPECIAL CONSIDERATIONS: BACT includes:

(1) Use, where possible, of water or chemicals for control of dust in the demolition of buildings or structures, construction operations, the grading of roads, or the clearing of land.

(2) Application of asphalt, oil, water, or suitable chemicals on dirt roads, material stockpiles, and other surfaces which can give rise to airborne dusts.

(3) Paving and maintenance of roadways.

(4) Prompt removal of earth or other material from paved streets onto which earth or other material has been transported by trucking or earthmoving equipment, erosion by water, or other means.

SCHEDULE: Approval orders are normally issued within 90 days of receipt of the notice of intent. The Bureau can grant itself a maximum of three 30-day extension periods if the review has not been completed within the initial 90 days. A copy of the notice of intent to approve or disapprove is sent to the applicant and to the directors of Federal, state, or local governing bodies that may be affected by the proposed air emissions. A copy of the notice of intent to approve or disapprove is also published in a local newspaper. If no substantive objections are received within 30 days, a final approval or disapproval order is issued.

PERMIT: APPROVAL OF WELL PLUGGING

LEGAL CITATION: Water Laws of Utah, UCA 73-5-9; Administrative Rules for Water Well Drillers, Utah Division of Water Rights, July 1, 1985

AGENCY/CONTACT: Utah State Engineer's Office
Utah Division of Water Rights
1636 West North Temple
Salt Lake City, Utah 84116
ATTN: Robert Morgan, State Engineer (801) 533-6071
Kent Jones, Distribution Engineer

PROCEDURE: The State Engineer may require that any well be plugged to prevent pollution or contamination of ground water. Prior to plugging wells, the State Engineer's Office must be notified to determine the acceptability of plugging techniques.

SPECIAL CONSIDERATIONS: The following procedures shall be implemented when sealing monitor wells:

(1) Temporary Abandonment. When any well is temporarily removed from service, the top of the well shall be sealed with a water-tight cap or seal. If the well is temporarily abandoned during construction, it shall be assumed that the well is permanently abandoned after 90 days, and a well driller's report will be submitted in compliance with Section 4.3 of the Regulations for Water Well Drillers.

(2) Permanent Abandonment. Any well that is to be permanently abandoned shall be filled in a manner so as to prevent the well from being a channel allowing the vertical movement of water and a possible source of contamination of the groundwater supply.

(3) Abandonment of Artesian Wells. A cement grout or concrete plug shall be placed in the confining stratum overlying the artesian zone so as to prevent subsurface leakage from the artesian zone. The remainder of the well shall be filled with cement grout, concrete, or puddled clay.

(4) Abandonment of Drilled and Jetted Wells. A cement grout or concrete plug shall be placed opposite all perforations or openings in the well casing. The remainder of the well shall be filled with cement grout, concrete, or puddled clay.

(5) Abandonment of Gravel Packed Wells. All gravel packed wells shall be pressure grouted throughout the perforated section of the well casing. The remainder of the well shall be filled with cement grout, concrete, or puddled clay.

(6) Plugged Wells. If it is desired to remove the well casing during abandonment, the well shall be plugged as the casing is removed. The well shall be plugged with cement grout, concrete, or puddled clay. In the case of gravel packed wells, the entire gravel section shall be pressure grouted.

Failure to diligently comply with the plugging requirements of the State Engineer constitutes a separate misdemeanor offense for each day of violation.

SCHEDULE: None specified.

PERMIT: CONDITIONAL USE PERMIT

LEGAL CITATION: Emery County Zoning Ordinances

AGENCY/CONTACT: Emery County Attorney's Office
P.O. Box 1099
Castle Dale, UT 84513
ATTN: Mark Tanner, Planner (801) 381-2543

PROCEDURE: The County will issue a Conditional Use Permit for the use of Borrow Site 2. A Conditional Use Permit application is submitted with the following information:

(1) Legal description.
(2) Purpose.
(3) Size of project (acres).
(4) Existing and intended use of property.
(5) Volume of material to be removed.

The County will issue requirements of reclamation and quantity limits when the permit is approved.

SPECIAL CONSIDERATIONS: None. An application fee of $100 is required.

SCHEDULE: Approximately 30 days.

A.2 CONCLUDING REMARKS

The preceding list of permits is considered to be comprehensive. No other issues or permit requirements have been identified which are considered relevant to the current remedial action plan for the Green River tailings site.

The activities discussed below do not require specific regulatory compliance or additional permits if the remedial action plan is modified significantly.

SPILL PREVENTION CONTROL AND COUNTERMEASURES PLAN (SPCC)

If on-site fuel and oil storage facilities exceed 1320 gallons, or any single on-site fuel or oil tank exceeds 660 gallons capacity, the EPA requires the operator to prepare an SPCC plan meeting the specifications cited in 40 CFR 112 and certified by a professional engineer. No permit is required, but a copy of the plan must be kept at the fuel storage site and be available for review by the EPA in the event of a spill or general inspection.

MONITOR WELL DRILLING

No formal permits are required from the Utah State Engineer's Office (SEO). The wells should be drilled by a Utah licensed well driller. In addition, location and depth information should be provided to the SEO upon completion of drilling.

OPEN BURNING PERMIT

Burning between October 31 and May 1 is allowed without a permit. Burning during the remaining months requires a permit to be issued by the Grand County Planning Commission.

APPENDIX B
RADON BARRIER DESIGN

APPENDIX B

RADON BARRIER DESIGN

The infiltration/radon barrier design will be confirmed or revised during construction of the disposal cell after the source term for all of the layers of contaminated materials have been positively identified. Specifications for the current infiltration/radon barrier design are found in section 2200 and the related drawings in Appendix F, Final Design. The original calculations determined that a 12-inch-thick minimum required radon barrier would be adequate to control radon flux to meet the U.S. Environmental Protection Agency standards (40 CFR 192). The current radon barrier of 36 inches is conservative because the final source term and quantities are not expected to increase to the extent that more than 36 inches of radon barrier would be needed.

APPENDIX C
RADIOLOGICAL SUPPORT PLAN

TABLE OF CONTENTS

C.1 INTRODUCTION

The Uranium Mill Tailings Radiation Control Act of 1978 (PL95-604) gave the responsibility of developing standards for remedial action to the U.S. Environmental Protection Agency (EPA). Section 108 of PL95-604 states that the U.S. Department of Energy (DOE) shall "select and perform remedial actions at the designated processing sites and disposal sites in accordance with the general standards" prescribed by the EPA. The EPA standards state:

> "Section 108 of the Act requires the Secretary of Energy to select and perform remedial actions with the concurrence of the Nuclear Regulatory Commission and the full participation of any State that pays part of the cost, and in consultation, as appropriate, with affected Indian Tribes and the Secretary of the Interior. These parties, in their respective roles under Section 108, are referred to hereafter as 'the implementing agencies.'
>
> The implementing agencies shall establish methods and procedures to provide 'reasonable assurance' that the provisions of Subparts A and B are satisfied. This should be done primarily through use of analytical models, in the case of Subpart A, and for Subpart B through measurements performed within the accuracy of currently available types of field and sampling procedures. These methods and procedures may be varied to suit conditions at specific sites."

Subpart B consists of standards for cleanup of land and buildings. The standards applicable to the project are:

> "Remedial actions shall be conducted so as to provide reasonable assurance that, <u>as a result of residual radioactive materials from any designated processing site</u>:
>
> A. the concentration of Radium-226 in land averaged over an area of 100 square meters shall not exceed the background level by more than --
>
> (1) 5 pCi/g, averaged over the first 15 cm of soil below the surface, and
>
> (2) 15 pCi/g, averaged over 15-cm-thick layers of soil more than 15 cm below the surface.
>
> B. in any occupied or habitable building --
>
> (1) the objective of remedial action shall be, and reasonable effort shall be made to achieve, an annual average (or equivalent) radon decay product concentration (including background) not to exceed 0.02 WL. In any case, the radon decay product concentration (including background) shall not exceed 0.03 WL, and
>
> (2) the level of gamma radiation shall not exceed the background level by more than 20 microR/h."

In addition to the EPA standards for buildings, removable surface alpha contamination shall not exceed those limits stated in the current Uranium Mill Tailings Remedial Action (UMTRA) Project Environmental, Health, and Safety Plan. These limits will ensure that potential airborne radionuclide concentrations will not exceed 10 CFR 20 Appendix B standards and that physical contact with the surfaces by occupants of the structures will not result in a measurable radiation exposure.

As indicated earlier, the standards suggest that the implementing agencies determine what methods and procedures will be used to provide "reasonable assurance" that the standards are met. Reasonable assurance implies that a site-specific analysis is appropriate where the cost of demonstrating compliance with the standards is to be weighed against the health risks or other impacts associated with leaving areas which slightly exceed the standards.

The sections which follow provide the procedures proposed for use at the Green River site. Consideration was given to the time required to collect samples and perform the analyses.

C.2 BASIS FOR RADIOLOGICAL SURVEY STRATEGY

The Green River site consists of a tailings pile, mill and ore storage areas, and some areas contaminated by windblown/waterborne tailings. Excavation to remove the tailings and off-pile contaminated material to the stabilization area will require removal of soil to a depth of several feet below grade. The disturbed areas will be restored to a grade that will control the drainage. The fill material will be uncontaminated and will minimize the potential health effects due to slight residual contamination.

Clean fill may not be required in some of the excavated areas, and residual contamination may remain exposed at the surface. In those areas where backfill after excavation is not required, residual contamination will be removed to the 5 pCi/g limit.

C.3 REMEDIAL ACTION RADIOLOGICAL SURVEY PLAN

Radiological surveys are performed for three purposes: site characterization, excavation control, and final radiological verification. Site characterization surveys or pre-remedial action surveys are performed to identify volumes of material which exceed the standard. The results are used for planning and engineering design. Excavation control monitoring is performed as the work is being done to guide and control the amount of contaminated material removed. Finally, when excavation control monitoring results indicate that there is a high probability that the area meets the standards, a final radiological survey is carefully performed and the results documented.

C.3.1 SITE CHARACTERIZATION SURVEYS

Field sampling programs conducted by Bendix Field Engineering Corporation (BFEC) have been used to identify the subsurface boundary of the tailings pile, as well as the depth and area of the former mill yards, ore storage, and windblown contaminated areas. Subsurface evaluations were performed using gamma well logging techniques and by analyzing cores from boreholes. In general, boreholes and surface measurements and samples were made on grids ranging from 100 by 100 feet to 200 by 200 feet. Additional measurements were performed in areas of radiological interest. The grid points have been identified by a land survey tied to a state plane survey point and all recordable data were located by these coordinates.

Radiometric surveys and sampling were conducted in the buildings at the site. Survey grids of 10 feet were established in each building. Additional points were added to ensure that a minimum of four samples were taken in each room. Exposure rate and removable and nonremovable alpha measurements were made at each grid point. Samples of the building foundations and associated subsurface soils were analyzed for Ra-226.

C.3.2 EXCAVATION CONTROL MONITORING

The purpose of excavation control monitoring is to guide the contractor's work through the use of real-time radiological measurements. It is designed to ensure that the 5 pCi/g (surface) and 15 pCi/g (subsurface) standards are met. In addition, it minimizes the possibility that material meeting the standards is also excavated. Properly performed excavation control monitoring simultaneously ensures that neither under-excavation nor over-excavation occurs.

Excavation will be monitored by qualified technicians relying principally on gamma field measurements employing hand-held instruments such as gamma-scintillation detectors. This technique will only be used where measurements are not seriously impaired by interference from nearby tailings deposits. In areas where significant interference exists, alternate monitoring techniques will be used. These techniques may include use of a shielded probe gamma-scintillation instrument (operated in a gross count mode or in a delta mode) or the immediate counting of soil samples. In all cases, these techniques will be routinely calibrated by comparison of the field measurements to soil samples analyzed in the laboratory and reported on a fully equilibrated dry-weight basis. Because the standards are based upon average areas of 100 m^2, the excavation control monitoring will be performed on areas of this characteristic size as well.

Elevated gamma-ray radiation fields preclude exclusive use of in-situ monitoring devices to estimate the surface radionuclide concentrations in soil on or immediately adjacent to the tailings pile. When in-situ measurements cannot be performed, the suggested method for analysis is to take individual or composite samples of soil, seal by canning, and immediately count the sample by gamma-ray spectrometry. Errors associated with this approach will be reduced by taking several samples 30 days prior to starting work to determine calibration factors. These samples will be counted, then held for subsequent analysis. They will be counted later after the Ra-226 daughters reach equilibrium. Analyses of these prepared samples can then be compared to standards. Several samples will be collected weekly during the remedial action and analyzed to provide a measure of the variation of the calibration factor.

C.3.3 BUILDING DECONTAMINATION CONTROL MONITORING

Four on-site buildings will require decontamination. The typical plan requires that in areas of known contamination, as determined by the site characterization surveys, measurements will be performed after each decontamination effort to assess the effectiveness of the effort. For potentially contaminated areas, measurements will be made at a minimum of either 100 percent of the area or at approximately 30 locations for surface areas of less than 500 square feet. In addition, measurements will be made in previously contaminated areas or other areas having a high probability of being contaminated.

C.3.4 FINAL RADIOLOGICAL VERIFICATION SURVEY FOR LAND

The final radiological survey will be based on 100 m^2 areas, with a composite sample used to obtain a measure of the average Ra-226 concentration in an area. The radium measurement will be reported on a dry-weight basis. For measurements based on gamma spectrometry of radium daughters, full equilibrium will be assured. It is expected that at least preliminary measurement results will be obtained prior to backfilling. The error limits for Ra-226 verification measurement techniques must be better than plus or minus 30 percent, at the 95 percent confidence level.

The average Ra-226 concentration on each 100 m^2 area which is surveyed will be determined by a composite sample composed of nine 15-cm-deep samples of approximately equal mass taken on a uniform spacing over the survey area. Other sampling protocols may be used if shown to adequately characterize the mean concentration and if approved in advance by the UMTRA Project Office.

C.3.5 FINAL RADIOLOGICAL VERIFICATION SURVEY FOR BUILDINGS

Four on-site buildings at Green River will require radiological verification. The typical plan requires that gamma surveys will be conducted using an instrument capable of detecting two microR/h above background. Buildings will be scanned while holding the instrument at three feet above the floor. Maximum, minimum, and average exposure rates will be recorded for each room of the buildings. All areas where the exposure rates exceed 20 microR/h above background will be noted.

Alpha detection instruments will be used to monitor surface contamination. A grid system will be constructed for each room of a structure which has been decontaminated. The grid size will be adjusted so that a minimum of 30 grid points will be defined by using grid lines not more than 30 feet nor less than three feet apart. Measurements will be made at each grid point and other areas of special radiological interest such as floor drains or areas that were the most highly contaminated. Contamination may be averaged over a 10-square-foot area and compared with the allowable limits, as provided in Section C.1. In cases where the total contamination is greater than the limits for removable contamination, measurements for assessing the removable contamination levels will be made.

Radon daughter concentration (RDC) measurements will be conducted in areas of the building where previous data indicated elevated radon progeny concentrations. An annual average radon daughter concentration will be determined for all structures to assure that they meet the standard.

C.4 DATA AND SAMPLE MANAGEMENT

During the cleanup operations, the Remedial Action Contractor will collect data to support excavation control. Data used in declaring an area adequately decontaminated will be documented in a format approved by the UMTRA Project Office.

Site characterization survey data, excavation control data, and the final radiological survey data will be collected using procedures and analytical methods meeting the requirements of the UMTRA Project Quality Assurance Program Plan (UMTRA-DOE/AL-400325). All data used in describing the final radiological condition of the site, as well as other data as specified by the UMTRA Project Office, will be provided in a convenient format. Data generated in the remedial action will be presented in a report documenting the final radiological condition of the property. Verification samples will be archived pending orders for transfer or disposal from the UMTRA Project Office.

C.5 CERTIFICATION

Certification is a professional judgement by an independent party that the remedial action has been completed according to the site-specific Remedial Action Plan and meets the applicable standards.

During the remedial action operations, the Remedial Action Contractor will make available to appropriate state agencies, Federal agencies, or UMTRA Project-designated contractors data related to the cleanup. In addition, samples collected during the cleanup operations may be split for analyses by these agencies to allow comparison of analytical results. These data, along with any additional data collected at the discretion of the certifying agent, will be used in the final certification report.

APPENDIX D
SUPPLEMENT, SITE CHARACTERIZATION

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF FIGURES (Concluded)

LIST OF TABLES

LIST OF TABLES (Concluded)

D.5 GROUNDWATER HYDROLOGY

D.5.1 INTRODUCTION

The U.S. Environmental Protection Agency (EPA) has established health and environmental protection regulations to correct and prevent groundwater contamination resulting from processing activities at inactive uranium mill tailings sites (40 CFR 192). The Uranium Mill Tailings Radiation Control Act (UMTRCA) of 1978 designated responsibility to the U.S. Department of Energy (DOE) for assessing the tailings sites. This assessment includes the following:

- o Definition of hydrogeologic characteristics of the environment, including the hydrostratigraphy, aquifer hydraulic parameters, areas of aquifer recharge and discharge, potentiometric surface, and groundwater velocity.

- o Comparison of existing water quality with background water quality and applicable EPA standards. Some discussion of EPA secondary drinking water quality parameters is included to define the general quality of the groundwater.

- o Definition of physical and chemical characteristics of the potential contaminant source, including concentration and leachability in relation to migration of contaminants in groundwater and hydraulically connected surface water.

- o Description of water resource use, including availability, current and future use, value, and alternative supplies.

- o Evaluation of current impacts to the groundwater system resulting from uranium processing activities.

On January 5, 1983, the EPA promulgated final standards for the disposal and cleanup of the inactive uranium processing sites under the UMTRCA (48 FR 590). On September 3, 1985, the groundwater provisions of the regulations (40 CFR 192.20(a)(2)-(3)) were remanded to the EPA by the U.S. Tenth Circuit Court of Appeals. On September 24, 1987, the EPA issued proposed groundwater regulations to replace those set aside (52 FR 36000). The DOE has commented on the proposed standards.

Water quality at the Green River tailings site was characterized and compared with the EPA's proposed groundwater standards for inactive uranium processing sites (Table D.5.1). The constituents listed in Table D.5.1 are most commonly associated with uranium mill tailings. The numerical concentration limits associated with the constituents reflect safe levels for public drinking water and are therefore the same as maximum concentration limits (MCLs) for EPA primary drinking water standards. Appendix VIII of the EPA's proposed standards includes a complete list of hazardous constituents that should be evaluated on a site-specific basis. These constituents include both organic and inorganic compounds and elements. Section E.3.1.1 of Appendix E contains a complete discussion of hazardous constituents that are associated with the uranium mill tailings at the Green River site.

The DOE has characterized conditions at the Green River processing site and does not anticipate that any changes to the remedial action will be required when the final EPA standards are issued. Upon issuance of these standards, the DOE will reevaluate the groundwater protection plan and determine the need for institutional controls on the public use of groundwater at the site, aquifer restoration, or other measures, and take appropriate action to comply with the final standards.

The following sections present details of the hydrogeologic characterization at the Green River site. Appendix E presents an assessment of future impacts to the groundwater system resulting from the proposed remedial actions, and a strategy for protecting water resources at the Green River site. Figures and tables are presented at the end of the text for ease in reading.

D.5.2 SITE CHARACTERIZATION SUMMARY

D.5.2.1 Summary

To comply with EPA standards for remedial actions at inactive uranium processing sites (40 CFR 192), the DOE has characterized the hydrogeology, water quality, and water resources at the Green River, Utah, designated site. Major points are summarized below, followed by a detailed discussion of the site characterization.

- Four distinct hydrostratigraphic units occur within the upper 200 feet of Quaternary and Cretaceous sediments beneath the site. In decending order these are: (1) Brown's Wash alluvium (top hydrostratigraphic unit); (2) shale and limestone of the Cedar Mountain Formation (upper-middle hydrostratigraphic unit); (3) sandstone, siltstone, and conglomerate of the Cedar Mountain Formation (lower-middle hydrostratigraphic unit); and (4) Buckhorn Conglomerate Member of the Cedar Mountain Formation. The Dakota Sandstone is present in some areas beneath the proposed disposal site. These units are underlain by the Jurassic-aged Morrison Formation.

- Average hydraulic conductivities of aquifer materials range from a low of 1.6 feet per day (ft/day) in the upper-middle shale unit to a high of 25.0 ft/day in the Brown's Wash alluvium. Average linear groundwater velocities range from 0.08 ft/day to 1.14 ft/day in the two units, respectively.

- Groundwater flow in the upper- and lower-middle hydrostratigraphic units is controlled by connected fractures and joints; strong, upward, vertical hydraulic gradients; and the attitude (dip) and lateral extent of the hydrostratigraphic units. Groundwater flow in the Brown's Wash alluvium and the upper-middle shale unit, where it lies beneath the alluvium, is also controlled by paleo-erosion of the upper-middle unit near the present tailings pile by a meandering Brown's Wash channel, and by the subsequent deposition of the Brown's Wash alluvium.

- Background groundwater quality in all four hydrostratigraphic units is characterized by concentrations of total dissolved solids (TDS), sulfate, and chloride that exceed EPA and state of Utah secondary drinking water standards. Groundwater in all four units is classified as Class II based on TDS (TDS greater than 1000 but less than 10,000 milligrams per liter (mg/l)), but it may be classified as Class III because of the concentrations of selenium, chromium, nitrate, and uranium in background samples that exceed proposed EPA MCLs for these constituents.

- Background groundwater quality in the top hydrostratigraphic unit is characterized by concentrations of chromium, molybdenum, nitrate, and selenium that exceed proposed EPA MCLs and state of Utah primary drinking water standards (except for molybdenum, which does not have a Utah standard).

- Background groundwater quality in the upper-middle hydrostratigraphic unit is characterized by concentrations of nitrate and selenium that exceed proposed EPA MCLs and state of Utah primary drinking water standards.

- Background groundwater quality in the lower-middle hydrostratigraphic unit is characterized by concentrations of molybdenum, nitrate, selenium, uranium, and gross alpha activity that exceed proposed EPA MCLs and state of Utah primary drinking water standards (except for molybdenum, which does not have a Utah standard).

- Background groundwater quality in the bottom hydrostratigraphic unit is characterized by concentrations of chromium, molybdenum, and selenium that exceed proposed EPA MCLs and state of Utah primary drinking water standards (except for molybdenum, which does not have a Utah standard).

- Contamination by tailings seepage is limited to the Brown's Wash alluvium and the upper-middle shale unit of the Cedar Mountain Formation beneath the present tailings pile. Major contaminants introduced by tailings seepage to these units include: molybdenum, nitrate (chemically reduced, in part due to ammonium), selenium, uranium, and gross alpha activity.

- The tailings seepage has been neutralized by the alluvium and shale bedrock beneath the tailings (the pH of the groundwater is near 7.0). Uranium concentrations in the alluvium and shale have not exceeded 3.11 mg/l in any of the wells, while concentrations in the tailings pore water (lysimeter samples) have been measured as high as 675 mg/l. Dilution by groundwater underflow and attenuation, probably as cation exchange in the alluvium and precipitation in the shale, have significantly lowered uranium concentrations, as well as other seepage contaminants, to well below the relatively high concentrations found in the tailings pore water.

D.5.2.2 Previous investigations

Bibliographies (ONWI, 1985; USGS, 1971-1985, 1972, 1964; La Pray and Hamblin, 1980; Buss and Geoltz, 1974; Childers and Smith, 1970; Buss, 1951) were reviewed to identify geological, hydrological, and hydrogeological investigations of the Green River site and vicinity. A number of regional studies (USGS, 1964; Howard and Love, 1945; Waring and Knechtel, 1936; Reeside, 1930, 1923; La Rue, 1916) were identified; however, much of the information contained in these reports is either outdated or not sufficient to aid in characterizing the hydrogeology of the site.

Five reconnaissance studies of the Paradox Basin, which contains the Green River site, were conducted as part of a program to evaluate the potential for storage of nuclear waste in salt deposits (Weir et al., 1983); one of these studies (Rush et al., 1982) included the area of the Green River tailings site.

A one-time sampling effort at the Green River tailings site was conducted by Geochemistry and Environmental Chemistry Research, Inc. (GECR, 1983). Data from this report are from sampling and analyses of groundwater and surface water from background areas, the area adjacent to the site, and the site. Soils samples were collected and archived, and have not been analyzed. Because of questionable quality assurance and control on the water sample analyses from the GECR report, the data were not used for analyses in this report.

An unpublished report by the DOE (1983) on the Green River site contains the results of drilling, groundwater sampling, and aquifer hydraulic testing of eight monitor wells; surface water sampling of Brown's Wash adjacent to and downstream of the site; and climatological data for the vicinity. Some of the data from the DOE (1983) report were used in this report. An engineering assessment (FBDU, 1981) includes site information as well as a summary of the milling operations and a history of the Green River site.

Hydrogeological data, including borehole logs, well completion records, groundwater elevations, aquifer hydraulic parameters, and water quality data, were collected at the Green River tailings site by the DOE during three drilling and testing phases from the fall of 1985 to the fall of 1987. Much of this information was included in an environmental assessment of the Green River tailings site (DOE, 1988a). All field and laboratory procedures and calculations were performed in accordance with the DOE's Standard Operating Procedures as contained in the Albuquerque Operations Manual (DOE, 1985).

Five two-inch diameter polyvinyl chloride (PVC) monitor wells, 28 four-inch diameter PVC monitor wells, and three two-inch diameter, low-carbon, galvanized steel well points were installed to characterize the Green River tailings and proposed disposal sites. The depths of these installations range from seven to 185 feet. Twelve exploratory geotechnical boreholes were also drilled, and ranged in depth from 16.5 to 32.5 feet. Lithologic logs were obtained from these boreholes prior to their abandonment by grouting and bentonite sealing from total depth to land surface. In addition, three suction lysimeters were installed in the unsaturated zone within the present tailings pile to characterize the pore water within the tailings. Since their installation, only one lysimeter has worked sufficiently to obtain samples. The locations of all monitor wells, lysimeters, abandoned boreholes, test pits, and surface water sampling sites included in this investigation are shown in Figure D.5.1. Following installation and development of the monitor wells, slug injection/withdrawal tests and short-duration (less than 25 hours) pumping drawdown/recovery tests were performed to estimate the hydraulic properties of the aquifer materials within the screened zones of the wells. The monitor wells were surveyed and static groundwater elevations in the wells were measured to determine vertical and horizontal hydraulic gradients and directions of groundwater flow. Table D.5.2 summarizes monitor well information for the Green River tailings site.

D.5.2.3 Geology and hydrostratigraphy

The Green River site is in east-central Utah on the nose of a shallow, northward plunging anticline that is repeated by the arcuate east-northeast to west-northwest trending Little Grand Wash fault, which lies three miles to the south of the site. Bedrock exposed at the surface in the site area consists of sedimentary units of Cretaceous and Jurassic age. Rock units lying beneath the surface range in age from Jurassic to Pennsylvanian and, at depth, include the salt- and gypsum-bearing Paradox Member of the Pennsylvanian Hermosa Formation.

In descending sequence, the geologic units within 200 feet of the surface in the Green River site area are as follows:

- o Brown's Wash alluvium beneath the present tailings pile, and alluvial terrace deposits beneath the proposed disposal site (Quaternary age).

- o Tununk Shale Member of the Mancos Shale (Cretaceous age).

- o Dakota Sandstone (Cretaceous age).

- o Cedar Mountain Formation (Cretaceous age).

The Brown's Wash alluvium consists of a mixture of silt, sand, gravel, and some small cobbles. The alluvium is limited to an area that extends 300 to 400 feet on either side of Brown's Wash, and varies in thickness from zero to 35 feet. The tailings pile directly overlies the Brown's Wash alluvium. The terrace deposits consist mostly of silt and sand and are approximately 20 feet thick in the vicinity of the proposed disposal site.

The Tununk Shale Member of the Mancos Shale consists of carbonaceous shale interbedded with thin beds of sandstone. It subcrops beneath the Brown's Wash alluvium in the eastern half of the site but is mostly eroded away by the channel of Brown's Wash in the western half of the site area. This unit is exposed in the east-central section of the site, and forms the bluff at the south end of the existing tailings pile. This shale unit forms a wedge that thins toward the south and disappears completely between the tailings pile and the proposed disposal site. South of the tailings pile, the Tununk Shale is between zero and 25 feet thick.

In the site area, the Dakota Sandstone consists of fractured to unfractured, weathered to fresh sandstone, shale, and conglomerate. It rests unconformably on top of the Cedar Mountain Formation. This unit varies from zero to 10 feet thick and extends both east and west of the tailings and disposal sites. The Dakota lies between unconformable contacts with either the Mancos Shale, the Brown's Wash alluvium, or the alluvial terrace deposits (top contact), and the Cedar Mountain Formation (bottom contact). Where it has not been eroded away, the shale and dense, well-cemented sandstone, and conglomerate of the Dakota Sandstone are either not saturated or only partly saturated beneath the tailings pile.

The Cedar Mountain Formation consists of mudstone, shale, limestone, sandstone, conglomerate, and occasional interbedded coal. The Cedar Mountain Formation lies unconformably beneath the Dakota Sandstone and in the site area is at least 150 feet thick. Lithologic units within the Dakota Sandstone and Mancos Shale can be distinguished from units within the Cedar Mountain

Formation by visual inspection. The Dakota and Mancos sandstones and shales are generally black (shale) to light tan (sandstone); units within the Cedar Mountain are generally shades of gray to maroon in color. Fractured and unfractured sandstone, sandstone conglomerates, and fractured shales or limestones within the Cedar Mountain Formation are the primary water-bearing units.

Figure D.5.1 shows the locations of cross sections (Figures D.5.2 through D.5.6) that show the hydrostratigraphy at the Green River tailings site. Figure D.5.7 is a fence diagram of the Green River site. The surface topography shown on the cross sections and fence diagram was developed from a topographic survey of the site. Subsurface lithologic data were obtained from borehole logs, visual inspection of rock core, and correlation of subsurface data with surface geology.

Hydrological investigations have shown that horizontal and vertical fracturing occurs in the Dakota Sandstone and Cedar Mountain Formation beneath the proposed disposal site. Core samples from monitor wells 562, 807, 812, 813, 814, 816, and 818 at the disposal site (see Figure D.5.1) show that vertical and near-vertical fractures exist in the bedrock and start at the top of the bedrock section. Fracturing is uniform and consistent through the Cedar Mountain Formation at least in the upper 60 feet of bedrock. The degree of fracturing varies from moderate to intense and is typical of the fracturing observed in outcrops of the Cedar Mountain Formation in the vicinity of the disposal site. Fracturing of the bedrock beneath the present tailings pile is variable. The flowing monitor well (581), completed in the sandstone unit beneath the pile, is evidence that the confining unit for the sandstone unit at this location (the overlying shale) must be relatively impermeable. Evidence (aquifer hydraulic conductivities and water levels) suggests that joints, fractures, or minor faulting may be controlling groundwater flow in the shallow bedrock approximately along the alignment of Brown's Wash.

Within the upper 200 feet of Quaternary and Cretaceous sediments, four distinct water-bearing units were defined at the Green River tailings site. These units are described as follows:

- The top hydrostratigraphic unit is the Brown's Wash alluvium. Groundwater in this unit is locally perched by the dense, well-cemented sandstone conglomerate of the Dakota Sandstone and the shale and limestone of the Cedar Mountain Formation (where these bedrock units are not fractured). Directly beneath the tailings pile, a paleochannel of Brown's Wash has eroded away the Dakota Sandstone, and the Brown's Wash alluvium directly overlies shale of the Cedar Mountain Formation.

- o The upper-middle hydrostratigraphic unit is the alternating layers of shale, limestone, and mudstone of the Cedar Mountain Formation.

- o The lower-middle hydrostratigraphic unit is a relatively thick, but laterally limited, sandstone of the Cedar Mountain Formation. The unit intertongues with the upper-middle unit and is beneath the present tailings pile and the proposed disposal site.

- o The bottom hydrostratigraphic unit is the Buckhorn Conglomerate Member of the Cedar Mountain Formation. This basal sandstone and sandstone conglomerate unit is 15 to 25 feet thick beneath the site area and is confined by overlying shale and mudstone.

Neither the lower-middle or bottom hydrostratigraphic units have been adversely affected by seepage through the present tailings pile. The lower-middle unit subcrops beneath the proposed disposal site and is therefore a potentially affected unit; the bottom unit is protected from any current or future contamination by strong, vertically upward hydraulic gradients and a thick, low-hydraulic-conductivity shale that overlies this unit. The following sections present more detailed discussions about the hydraulic characteristics and flow of groundwater within these units.

D.5.2.4 <u>Hydraulic characteristics</u>

A summary of the hydraulic characteristics of the top, upper-middle, lower-middle, and bottom hydrostratigraphic units is presented in Table D.5.3. A number of methods were used to calculate values of hydraulic conductivity for the units. The methods of analyses include the following:

- o Ferris-Knowles slug test analysis (Ferris and Knowles, 1963).

- o Cooper, Bredehoeft, and Papadopulos slug test analysis (Cooper et al., 1967).

- o Bouwer-Rice slug test analysis (Bouwer and Rice, 1967).

- o Pumping drawdown analyses.

- o Pumping recovery analyses.

Slug test data from monitor wells 561, 581, 582, 583, 584, 585, 586, 587, 588, 701, 704, 707, 806, 807, 811, 813, 815, and 818 were analyzed by the Ferris-Knowles method. This method is best suited for fully developed wells that are open to the full thickness of an artesian aquifer of small to moderate transmissivity (less than 50,000 gallons per day per foot (gpd/ft)); it is also suited to some unconfined aquifers (Ferris and Knowles, 1963). The Ferris-Knowles equation is as follows:

$$k = \frac{q(1/t)}{4\pi sL}$$

where

k = hydraulic conductivity (ft/day).

q = slugged volume (cubic ft).

t = time (days).

s = residual drawdown at time t_s (ft).

L = length of interval being tested (ft).

The values of $1/t$ and s are obtained from a straight-line fit through the plotted data points. These data are available from the Albuquerque UMTRA Project Office, Albuquerque, New Mexico.

Slug test data from monitor wells 561, 582, 583, 584, 585, 586, 587, 588, 701, 704, 707, 806, 807, 811, 813, 815, and 818 were analyzed using the Cooper, Bredehoeft, and Papadopulos (Cooper et al., 1967) method, which has requirements similar to the Ferris-Knowles method, and is as follows:

$$k = \frac{r^2}{tL}$$

where

k = hydraulic conductivity (ft/day).

r = radius of well casing (ft).

t = time for point in "matched-type curve" (days).

L = length of interval being tested (ft).

The value t is obtained by matching data points of residual drawdown versus time (log scale) to a "type curve" referenced by Cooper, Bredehoeft, and Papadopulos (Lohman, 1972).

Short-duration aquifer pumping tests were analyzed from monitor wells 581, 582, 586, 587, 588, and 813 by the single-well pumping drawdown or recovery method, formally recognized as the modified Theis nonequilibrium formula (Freeze and Cherry, 1979). The pumping drawdown or recovery formula is as follows:

$$k = \frac{264q}{sL}$$

where

k = hydraulic conductivity (gpd/ft^2).

q = average pumping rate for the duration of the test (gpm).

s = drawdown per one log cycle (ft).

L = length of interval being tested (ft).

An aquifer pumping drawdown test was conducted on alluvial well 702 (DOE, 1983). Also, slug tests were performed and analyzed from monitor wells 701, 702, 704, 705, 706, and 707 using the Bouwer-Rice method (DOE, 1983).

Assumptions inherent in the analyses of the aquifer hydraulic test data, regardless of the method of analysis, are as follows:

- o The unit being tested is homogeneous and isotropic.
- o The radius of the well is small in comparison to the extent of the aquifer.
- o The removal of the slug and the development of initial residual drawdown are instantaneous.
- o The influence of the filter pack is negligible.

To obtain the average hydraulic conductivity values listed in Table D.5.3, values from each analysis were summed and an arithmetic mean was calculated. Wells 701, 704, and 707 were tested in 1983 and 1986. Alluvial wells 702, 705, and 706 were only tested in 1983. All other wells listed in Table D.5.3 were tested in 1986 and 1987.

Average linear velocities listed in Table D.5.3 were calculated as follows (Freeze and Cherry, 1979):

$$v = \frac{ki}{n}$$

where

v = average linear velocity (ft/day).

k = average saturated hydraulic conductivity (ft/day).

i = average hydraulic gradient (ft/ft).

n = assumed porosity of aquifer material (dimensionless).

The saturated hydraulic conductivity of the unfractured bedrock of the Cedar Mountain Formation was measured by the triaxial backpressure falling head method (Table D.5.4). The measured conductivity is low, ranging from 2.4 x 10^{-8} centimeters per second (cm/s) to 2.4 x 10^{-11} cm/s. These values indicate that flow of groundwater in the bedrock is controlled by interconnected fractures and joints.

More detailed discussions of the hydraulic characteristics of the four hydrostratigraphic units are presented in the following sections. Table D.5.5 presents static groundwater elevations in the monitor wells for four sampling periods: June, 1986; September, 1986; March, 1987; and October, 1987.

D.5.2.5 Groundwater flow

Top hydrostratigraphic unit

Shallow, unconfined groundwater is present in Brown's Wash alluvium beneath the present tailings pile. The occurrence of this shallow groundwater is limited by the lateral extent of the alluvium. The top unit is a maximum of 600 feet wide near the tailings pile. Monitor wells 702, 704, 705, 706, 707, 708, 808, and well points 563, 564, and 821 are completed in this unit.

A water table contour map of the top hydrostratigraphic unit is presented in Figure D.5.8. This contour map was developed from water level data and the surveyed elevations of the wells in October, 1987 (see Table D.5.5). The depth to groundwater ranges from nine to 17 feet below the surface in the top unit. The hydraulic gradient within the top unit ranges from 0.0029 ft/ft near monitor well 707 to 0.0125 ft/ft near monitor wells 702 and 808.

Table D.5.6 presents a summary of aquifer hydraulic characteristics for the top hydrostratigraphic unit. The calculated geometric mean linear velocity of groundwater in the top unit is 1.14 ft/day. Groundwater in the top unit is recharged by flow from the upper-middle shale unit from the south, and by infiltration of surface runoff and precipitation in the channel of Brown's Wash. Groundwater discharges from Brown's Wash alluvium into the channel of Brown's Wash at a point west of the tailings pile where the site access bridge crosses Brown's Wash (see Figure D.5.1). From this point west to the Green River, the Dakota Sandstone and Cedar Mountain Formation inhibit the downward movement of water in the channel; however, a portion of this water likely infiltrates into the bedrock, especially where fractures are present. Water that flows west in the channel eventually mixes with backwater from the Green River (at surface-water sampling site 526, shown on Figure D.5.1). Groundwater also discharges from the Brown's Wash alluvium into the underlying upper-middle shale unit of the Cedar Mountain Formation, to the atmosphere as evaporation, and to the tamarisk vegetation that lines the channel of Brown's Wash. The DOE (1988a) measured the base flow in Brown's Wash channel in November, 1985, at 2.3 gallons per minute (gpm). The measurement was made immediately west of the access bridge to the site near well point 564 (see Figure D.5.1). The remainder of the shallow alluvial groundwater from beneath the present tailings pile is lost to evapotranspiration and vertical downward leakage into the Cedar Mountain Formation. Since well points 564 and 821 and monitor well 706 are dry (see Figure D.5.1), very little flow is assumed to move downgradient to the alluvium west of monitor wells 706.

The groundwater flux through the top hydrostratigraphic unit beneath the present tailings pile can be estimated by using Darcy's Law (Todd, 1980) as follows:

$$Q = WDki$$

where

Q = groundwater flux (ft^3/day).

W = saturated width of aquifer perpendicular to groundwater flow beneath the tailings.

D = saturated height of aquifer beneath the tailings (ft).

k = saturated hydraulic conductivity of the alluvium (ft/yr).

i = hydraulic gradient (ft/ft).

To calculate the groundwater flux in the alluvium beneath the tailings, the projected area perpendicular to the flow was divided into three areas represented by monitor wells 702 and 808 for the eastern area; monitor well 704 for the middle area; and monitor well 705 for the western area. The groundwater flux for each of these areas and the total flux in the alluvium beneath the tailings is summarized in Table D.5.7. The total flux is estimated to be 9.9 gpm beneath the tailings.

Upper-middle hydrostratigraphic unit

Confined and semiconfined groundwater is present in the upper-middle unit beneath the Green River tailings site. This unit consists mostly of limestone and shale of the Cedar Mountain Formation. Beneath the tailings and the proposed disposal site, the upper-middle unit is separated into two units by a sandstone and conglomerate channel deposit. To the west and east of the tailings and proposed disposal site this sandstone and conglomerate is not present or intertongues as thin layers with the upper-middle shale unit (see Figures D.5.2, D.5.3, and D.5.4).

Beneath the proposed disposal site, fracturing occurs in the upper- and lower-middle units. A total of six core holes were drilled beneath and peripheral to the proposed disposal site. Core from all of these holes shows moderate to intense vertical and horizontal fracturing and fractures extending from the upper-middle unit down into the lower-middle unit (DOE, 1987a). Monitor wells completed in the upper-middle unit include 583, 584, 585, 701, 806, 807 (completed below the sandstone and conglomerate channel deposit), 809, 810, 812, 814, 816, 822, and 823. Monitor wells 812, 814, 816, 822, and 823 were installed at the disposal site; only well 816 encountered groundwater (at a depth of 60 feet). Depth to groundwater in the upper-middle unit beneath the tailings surface is about 26 feet at monitor well 701.

A potentiometric contour map of the upper-middle hydrostratigraphic unit is presented in Figure D.5.9. This contour map was developed from water level data and the surveyed water elevations in the wells in October, 1987 (see Table D.5.5). The hydraulic gradient within the upper-middle hydrostratigraphic unit ranges from 0.0063 to 0.0083 ft/ft. Groundwater flux in the upper-middle unit is controlled by fractures, joints, or minor faulting, which is most evident in the vicinity of the tailings pile. A "trough" is present in the potentiometric surface, which trends east-west and is just south of the channel of Brown's Wash (see Figure D.5.9). Groundwater flux in the upper-middle unit is also controlled by vertical recharge from the overlying alluvial aquifer and the underlying lower-middle unit.

Table D.5.8 presents a summary of aquifer hydraulic characteristics for the upper-middle unit. The calculated average linear velocity of groundwater in the upper-middle unit ranges between 0.01 and 0.71 ft/day; the geometric mean velocity is 0.08 ft/day. Groundwater flux through the upper-middle unit beneath the present tailings pile was calculated based on the calculated hydraulic conductivities and water levels from monitor wells 584 and 701. The method for calculating groundwater flux was the same as that used to calculate flux through the top hydrostratigraphic unit. The total flux is estimated to be 4.9 gpm beneath the tailings in the upper-middle unit (Table D.5.9).

Lower-middle hydrostratigraphic unit

The lower-middle hydrostratigraphic unit is the sandstone and conglomerate channel deposit within the upper-middle geologic unit of the Cedar Mountain Formation. This unit is a maximum of 30 feet thick and is confined in the area of the present tailings pile by overlying shales and limestones of the upper-middle unit. The lower-middle unit does not appear to be present, or it intertongues as thin lenses with the limestone and shale, east and west of the tailings (see Figures D.5.2, D.5.3, and D.5.4). Monitor well 581 is drilled and completed in this unit beneath the tailings, and it flows at the surface. Monitor wells 561 and 562 are screened in both the upper-middle and lower-middle units and data collected from these wells may not represent actual conditions in either unit. However, monitor well 562 is completed beneath the proposed disposal site and well 561 is west of the disposal site; because of the fracturing present in the upper-middle and lower-middle units at the disposal site, these two units are probably somewhat hydraulically connected, and the screened intervals in monitor wells 561 and 562 probably include the zone of hydraulic connection. Other monitor wells drilled and completed in the lower-middle unit include 811, 813, and 815. Background monitor well 811, east of the tailings pile near Brown's Wash (see Figure D.5.1), encountered only thin, separated lenses of sandstone that are probably of the lower-middle unit.

A potentiometric contour map of the lower-middle unit is presented in Figure D.5.10. This map was developed from water level data for October 1987 (See Table D.5.4) and the surveyed elevations of the monitor wells. The potentiometric surface in the lower middle unit is two to three feet above the surface of the tailings at monitor well 581. The depth to water in this unit is approximately 60 feet at the proposed disposal site. The hydraulic gradient within the lower-middle unit ranges from 0.0083 to 0.025 ft/ft.

The flow of groundwater in the lower-middle unit is strongly influenced by the attitude (dip) of the unit, its limited lateral extent to the east and west, and its recharge by underlying aquifers. Rock cores from monitor wells 562, 807, and 813 indicate this unit is fractured and is probably hydraulically connected with the overlying upper-middle shale unit beneath the proposed disposal site; however, the lower-middle unit is confined by the shale beneath the present tailings. Additionally, monitor well 581, which is drilled and completed in the lower-middle unit, flows at the surface. The strong, vertically upward hydraulic gradient between the upper-middle and lower-middle units beneath the tailings pile has prevented any tailings seepage from moving into the lower-middle unit.

Table D.5.10 presents a summary of aquifer hydraulic characteristics for the lower-middle hydrostratigraphic unit. The calculated average linear velocity of groundwater in the lower-middle unit ranges between 0.02 and 2.7 ft/day; the geometric mean is 0.14 ft/day. Groundwater flux through the lower-middle unit beneath the tailings was not calculated since this unit has not been affected by tailings seepage.

Bottom hydrostratigraphic unit

The Buckhorn Conglomerate Member of the Cedar Mountain Formation has been defined as the bottom hydrostratigraphic unit. Confined groundwater is present beneath the tailings site vicinity in this unit. The unit is 15 to 25 feet thick in the site vicinity and is confined by the maroon to gray-blue shales and mudstones that separate the bottom unit from the overlying hydrostratigraphic units. Monitor wells 582 and 819, drilled and completed near Brown's Wash west of the tailings, flow at the surface. The other monitor wells completed in this formation (586, 587, 588, and 818) do not flow because they are at a higher elevation than the flowing wells. Monitor well 817, located east of the tailings near Brown's Wash (see Figure D.5.1), was thought to be drilled and completed in the bottom unit. Detailed analyses and comparison with other well data showed that well 817 is probably screened somewhere below the lower-middle unit (see Figure D.5.3). Because of the uncertainty associated with the completion of monitor well 817, data from the well have not been included in hydrogeologic analyses of any of the units.

A potentiometric contour map of the bottom unit is presented in Figure D.5.11. This contour map was developed from water level data for October 1987 (see Table D.5.4) and the surveyed elevations of the monitor wells. The potentiometric surface in the bottom unit is five to 14 feet above land surface in the vicinity of the present tailings, and 56 to 71 feet below land surface in the vicinity of the proposed disposal site. The hydraulic gradient within the bottom unit ranges from 0.040 to 0.044 ft/ft.

Table D.5.11 presents a summary of aquifer hydraulic characteristics for the bottom unit. The calculated average linear velocity of groundwater in the bottom unit ranges from 0.072 to 0.17 ft/day; the geometric mean is 0.12 ft/day. Groundwater flux through the bottom unit beneath the tailings was not calculated since tailings seepage has not affected this unit. Because of overlying confining layers and strong, vertically upward hydraulic gradients between the bottom unit and the two presently contaminated units, the bottom unit will not become contaminated from tailings seepage.

Vertical hydraulic gradients

Strong, vertically upward hydraulic gradients exist between the bedrock units in the vicinity of the Green River tailings site. These gradients have prevented the downward movement of tailings seepage into the lower-middle and bottom hydrostratigraphic units beneath the present tailings pile. Beneath the proposed disposal site these gradients may limit the amount of mixing of any tailings seepage (as a result of the proposed remedial action) between the upper-middle and lower-middle units. Additionally, the strong gradients will restrict the movement of any tailings seepage into the bottom unit. Tables D.5.12 and D.5.13 summarize the vertical hydraulic gradients at the present tailings site and the proposed disposal site, respectively.

D.5.2.6 Background groundwater quality

Background groundwater quality in the four hydrostratigraphic units at the Green River site was determined for the following constituents listed in the proposed EPA standards (40 CFR 192): chromium; molybdenum; nitrate; selenium; radium-226 and 228; uranium; and gross alpha activity. The other constituents listed in the proposed EPA standards (see Table D.5.1) were found to have levels below detection for the first two rounds of sampling in June 1986 and September 1986; consequently, these remaining constituents were excluded from subsequent sampling rounds and are not considered to be present as contamination in groundwater at the Green River tailings site. Table D.5.14 describes all of the groundwater sampling locations and Table D.5.15 presents the results of the chemical analyses for all of the wells and well points. Figure D.5.12 is a trilinear plot of the monitor wells at the Green River site. The trilinear plot shows the general types of groundwater in the alluvium and Cedar Mountain Formation.

Top hydrostratigraphic unit

The locations of background monitor well 707 and well point 563 are shown on Figure D.5.1. These monitoring locations are upstream and upgradient of the tailings.

A background groundwater quality summary of the top unit is presented in Table D.5.16. The maximum background concentration of the range exceeds the proposed EPA MCL for all the constituents in the table except for Ra-226 and 228. Many other constituents exceed EPA secondary and state of Utah drinking water MCLs. These include (but are not limited to): chloride (>250 mg/l), sulfate (>5500 mg/l), and TDS (>9000 mg/l). (See Table D.5.15 for specific concentrations of these constituents.) The general water type for the top unit is calcium or sodium sulfate; the water is Class II based on TDS (greater than 1000 mg/l TDS but less than 10,000 mg/l), but is Class III based on the high levels of chromium, molybdenum, nitrate, selenium, and uranium that occur naturally.

Upper-middle hydrostratigraphic unit

The locations of background monitor wells 816 and 806 are shown on Figure D.5.1. Monitor well 806 is upgradient of the tailings, and monitor well 816 is upgradient and updip of the tailings.

A background groundwater quality summary of the upper-middle unit is presented in Table D.5.17. The wide range of background quality reflects the range in concentrations found at each well. High concentrations of the contaminants listed in Table D.5.17 are found at well 816, which is located south (upgradient) of the tailings at the proposed disposal site. Proposed EPA MCLs for nitrate, selenium, and gross alpha activity are exceeded in monitor well 816. The measured uranium concentration is very close to the proposed MCL and chromium has been measured at levels as high as the MCL. The nature of the contamination present in this well suggests the source may be from the surface, as well as from recharge by naturally contaminated water from underlying aquifers. The general water type in background well 806 is sodium bicarbonate. The concentrations of both sodium and sulfate are much higher in monitor well 816 than in monitor well 806, but since alkalinity was not determined for well 816 (limited sample quantity), well 816 is not plotted on the trilinear plot. The water in the upper-middle unit is Class II based on TDS, but is Class III based on the high nitrate and selenium concentrations found in monitor well 816.

Monitor well 807 is completed in the upper-middle shale unit below the lower-middle sandstone (see Figure D.5.2). The screened interval in well 807 is from 78 to 98 feet (see Table D.5.2). The water quality analysis of a sample taken from this well in July 1988 (see Table D.5.15) shows that cadmium (0.125 mg/l), chromium (0.06 mg/l), nitrate (1280 mg/l), and selenium (0.322 mg/l) concentrations exceed proposed EPA and state of Utah MCLs for these constituents. In addition, the boron concentration was measured at 0.84 mg/l, which is slightly greater than the state of Utah maximum concentration limit for boron (see Table D.5.1). Finally, total dissolved solids were measured at 11,700 mg/l, and the sulfate concentration was 6450 mg/l. Since this saturated zone within the Cedar Mountain Formation is isolated from surface contamination by strong, vertically upward hydraulic gradients, the source for the contaminants formed within this unit is from somewhere off the site, and possibly from below the elevation of the well screen. It is possible that contaminants were discharged into this zone by injection, but there is no evidence that this is the case (Day, 1988).

Lower-middle hydrostratigraphic unit

The locations of background monitor wells 562, 811, ar 813 are shown on Figure D.5.1. Monitor well 811 is upgradient of the tailings, and monitor wells 562 and 813 are upgradient and updip of the tailings.

A background groundwater quality summary of the lower-middle unit is presented in Table D.5.18. The background quality range for this unit is similar to that of the upper-middle unit. Beneath the proposed disposal area, the upper- and lower-middle hydrostratigraphic units may be hydraulically connected by numerous vertical fractures. In the north, away from the disposal area and toward the present tailings pile, the vertical fractures are not as intense or abundant and the lower-middle unit is confined by the overlying shales and limestones of the upper-middle unit. Background concentrations of chromium, molybdenum, nitrate, selenium, uranium, and gross alpha activity exceed the proposed EPA MCLs south (upgradient) of the tailings at the proposed disposal site. The source of this contamination, like that found in the upper-middle unit, is probably from upgradient sources south of the disposal area. There is no evidence at the ground surface that the proposed disposal site is a source of contamination. The general water type in the lower-middle unit is sodium sulfate; the water is Class II, based on TDS, but is Class III based on high levels of chromium, molybdenum, nitrate, selenium, uranium, and gross alpha activity.

Bottom hydrostratigraphic unit

The locations of background monitor wells 586, 587, 588, 817, and 818 are shown on Figure D.5.1. These monitor wells are upgradient and updip of the tailings.

Groundwater in this unit is much better in quality than the three shallower units; TDS levels are near 2000 mg/l. The general water type is sodium sulfate and the water is at the lower end of Class II, based on TDS, but is also Class III because of high levels of chromium, molybdenum, selenium, and gross alpha activity.

For the September 1986 and March 1987 rounds of water sampling, monitor wells 586 and 587 were considered to be cement grout contaminated since the time the wells were drilled and completed. The pH of the water samples from these wells ranged from 9.92 to 11.61 standard units. For the October, 1987, sampling, the pH was measured as 8.10 in monitor well 586 and 9.35 in monitor well 587, indicating the majority of the grout was removed from the producing intervals during the purging (sampling) process. The pH values for all of the sampling dates for monitor wells 586, 587, and 818 were plotted versus molybdenum, nitrate, selenium, uranium, and sulfate concentrations on a linear-linear graph (Figure D.5.13) to show the effect of pH on the concentrations of these constituents. A linear regression was done for each constituent, the coefficient of determination (r^2) was calculated, and Student's "t" statistic (McClave and Dietrich, 1979) was calculated to test the null hypothesis that the slopes of the best-fit regression lines for each parameter are not different from zero. The calculated "t" statistics indicate that at a 99 percent level of confidence there does not appear to be any linear relationship between pH and the concentrations of the constituents tested. Based on these results, values for these constituents and all other constituents analyzed from wells 586, 587, and 818 were included in the background water quality calculations, regardless of the water pH at the time of sampling.

A background groundwater quality summary of the bottom unit is presented in Table D.5.19. Concentrations of chromium, molybdenum, selenium, and gross alpha activity in the bottom unit are slightly higher than the proposed EPA standards for these constituents. These levels probably reflect high natural levels of these constituents, and indicate that the high levels of these constituents found in the over-lying hydrostratigraphic units may also be (at least in part) from natural sources.

<u>Summary</u>

The range of background groundwater quality in the upper- and lower-middle (Cedar Mountain Formation) hydrostratigraphic units is wide because background monitor wells are located both east (upstream) and south (updip) of the tailings. The wells south of the tailings (at the proposed disposal site) indicate there is a source of contamination upgradient of the disposal site that is not related to the milling processes since it would be outside the boundary of the mill site. If the high nitrate levels are an indication of the source, it may be from activities associated with the White Sands Missile Range test complex (DOE, 1988a). High levels of chromium, molybdenum, and selenium in the bottom hydrostratigraphic unit indicate these constituents are from natural sources; because this unit is confined by a thick shale unit in the vicinity of the tailings site contamination from the surface is unlikely. Because the high background levels of nitrate, molybdenum, chromium, and selenium indicate contamination from natural sources, groundwater in all four hydrostratigraphic units at the Green River site may be classified as Class III, according to 40 CFR 192.21(g), which states that Class III groundwater includes water that is not a current or potential source of drinking water because widespread, ambient contamination not due to activities involving residual radioactive materials from a designated processing site exists that cannot be cleaned up by using treatment methods reasonably employed in public water-supply systems.

The town of Green River currently takes water from the Green River upstream of its confluence with Brown's Wash for domestic use and irrigation. Because an ample supply of good-quality surface water is available for domestic use, the development of groundwater in the potentially affected environment of the Green River tailings site is highly unlikely. See Section D.5.2.10 for a more complete discussion of groundwater use, value, and alternate supplies at the Green River tailings site.

D.5.2.7 Extent of existing contamination

Percolation of tailings seepage into the groundwater system beneath the tailings pile has adversely impacted the water quality in both the top and upper-middle hydrostratigraphic units. The vertical extent of contamination is confined to these two shallow units by strong, vertically upward hydraulic gradients between the upper-middle unit and the underlying units. The maximum potential depth of contamination in groundwater beneath the surface of the present tailings pile is about 65 feet.

Top hydrostratigraphic unit

Gross alpha activity, molybdenum, nitrate, selenium, and uranium concentrations exceed background levels and proposed EPA and state of Utah groundwater MCLs beneath and downgradient of the tailings. Table D.5.20 shows the maximum and minimum observed concentrations of contaminants in the top unit and the proposed EPA maximum concentration limits. The range in concentrations of contaminants varies widely from sampling to sampling, probably in response to evaporation and percolation of rainfall and snowmelt through the tailings; this type of variation is also seen in the pore water sample analyses for the same reasons (see Section D.5.3.5). Figures D.5.14 through D.5.18 show the lateral extent of contamination as gross alpha activity, molybdenum, nitrate, selenium, and uranium, respectively, in the top unit (Brown's Wash alluvium) and in the channel of Brown's Wash, based on the maximum observed concentrations.

The contamination resulting from tailings seepage travels downgradient through the alluvium toward the northwest and the channel of Brown's Wash. Once in Brown's Wash, the contaminants move west with groundwater flow in the shallow alluvium or on the surface. Surface water sample analyses from Brown's Wash (DOE, 1988a) indicate contaminated groundwater discharges to Brown's Wash; however, flow in the channel is intermittent and the concentrations of contaminants (as well as major anions and cations) are a function of the evaporation of water in the channel (i.e., evaporation causes a relative increase in concentration of the contaminants). The contaminated water travels downstream (west) in Brown's Wash and mixes with backwater from the Green River approximately 400 feet west of surface water sampling station 710 (see Figures D.5.14 through D.5.18). Water quality analyses from samples of Green River water upstream and downstream from its confluence with Brown's Wash show that the discharge of contaminated water from Brown's Wash to the Green River has no adverse affect on the water quality of the Green River (DOE, 1988a). This is because the contaminants are diluted by a factor of 10^5 to 10^6 once they mix with the Green River.

As part of the site characterization, monitor well 705 (on-site and completed in the alluvium) was sampled and analyzed for EPA priority organic pollutants in July 1986. The analyses measured 13 parts per billion (ppb) of methylene chloride, but it is noted by the analytical laboratory that the elevated value may be a result of laboratory contamination. Two other unknown, semivolatile compounds were tentatively identified by the lab to have concentrations of 100 and 40 ppb. In July 1988, monitor well 705 together with monitor wells 561, 562, 583, 806, 807, and 816, and lysimeter 714 (see Figure D.5.1 for locations) were sampled for volatile and semi-volatile organic compounds. The analyses showed that the only compound detected in confirmable concentrations was methylene chloride; methylene chloride was also detected in the trip blank for this batch of samples. Based on these results, methylene chloride is suspected of being present as a result of contamination by the analytical laboratory. These analytical results are on file at the UMTRA Project Office in Albuquerque, New Mexico.

Contamination as ammonium was also identified in the top unit. Figure D.5.19 shows the extent of ammonium contamination in Brown's Wash alluvium and the channel of Brown's Wash. Ammonium was used in the milling process (see Section D.5.2.8) and may be present in groundwater beneath the tailings by the reduction of nitrate (NO_3^-) within the tailings to ammonium (NH_4^+). The chemical characteristics of the tailings pore fluid are discussed in detail in Section D.5.2.8; geochemical conditions present in the Green River site area are discussed in Section D.5.2.9.

Upper-middle hydrostratigraphic unit

Gross alpha activity, molybdenum, nitrate, selenium, and uranium exceed background levels and proposed EPA and state of Utah groundwater standards beneath and downgradient of the tailings. Table D.5.21 shows the maximum observed concentrations of contaminants in the upper-middle unit and the proposed EPA MCLs. Figures D.5.20 through D.5.24 show the lateral extent of contamination as gross alpha activity, molybdenum, nitrate, selenium, and uranium, respectively, in the upper-middle hydrostratigraphic unit, based on the maximum observed concentrations.

Contamination from tailings seepage in the upper-middle unit extends northwest from the tailings pile (from monitor well 701, on the site), roughly following the "trough" shown by the potentiometric contours (see Figures D.5.20 through D.5.24). This trough probably is a result of higher secondary permeability in the shale caused by joints, fractures, or minor faulting that is oriented the same direction as the trough. Groundwater flow in the upper-middle unit is discussed in more detail in Section D.5.2.4.

Contamination is also present in monitor well 583 west of the tailings and Brown's Wash (see Figures D.5.20 through D.5.24). This contamination is probably a result of seepage of contaminated water in Brown's Wash down into the bedrock channel bottom. As discussed previously, the contaminated water in Brown's Wash is a result of the discharge of contaminated alluvial groundwater into the channel adjacent to and downgradient of the tailings.

Contamination as ammonium was identified in monitor well 701 on the site; however, the ammonium appears to be limited to the area directly beneath the tailings because elevated levels of ammonium are not found in any of the off-site monitor wells. The maximum observed concentration of ammonium observed in monitor well 701 was 47 mg/l.

D.5.2.8 Tailings and milling process characterization

Tailings

The tailings pile at the Green River site is eight acres in area. The tailings are not presently saturated and there is no evidence of a groundwater mound beneath the tailings. The depth to groundwater beneath the base of the tailings ranges from four to ten feet, using the available monitor well and water level information.

The tailings are a fairly well-sorted, white to pink sand with some silt. Based on laboratory test data (Table D.5.22), the average saturated hydraulic conductivity of compacted tailings is 1.5×10^{-4} cm/s. This value is probably representative of the tailings since there are no slimes within the pile and the tailings are uniform in texture. Under natural, uncompacted conditions, the vertical hydraulic conductivity is probably greater than 10^{-4} cm/s. The horizontal hydraulic conductivity of the underlying Brown's Wash alluvium (top hydrostratigraphic unit) is near 1×10^{-2} cm/s, based on average hydraulic conductivities at monitor wells 702, 704, 705, and 708 (see Table D.5.7). Considering that the alluvium is anisotropic (Bouwer, 1978), the vertical hydraulic conductivity is probably in the range of 5×10^{-3} to 1×10^{-3} cm/s.

In an attempt to calculate the current percolation rate through the present tailings pile, the following mixing relationship was used:

$$C_b(Q_r - Q_t) + C_tQ_t = C_rQ_r$$

where

C_b = concentration of water quality constituent upgradient (background) of the tailings (mg/l).

Q_r = volume flux rate of alluvial groundwater beneath the tailings (resultant volume flux rate from mixing the background groundwater with the fluid percolating through the tailings) (gpm).

Q_t = volume flux rate (percolation) through the tailings (gpm).

C_t = concentration of water quality constituent in tailings pore fluid (lysimeter sample) (mg/l).

C_r = concentration of water quality constituent in the alluvium beneath the tailings (resultant concentration from mixing background alluvial water with tailings pore water) (mg/l).

Using Q_r = 9.9 gpm (see Table D.5.8), average pore water concentrations from lysimeter GRN01-714 (Table D.5.23), average background groundwater concentrations from alluvial monitor wells 563 and 707, and resultant groundwater concentrations from alluvial on-site wells 702, 704, and 705, Q_t was calculated to be 0.010 gpm using both uranium and manganese concentrations. Other constituents were considered but were not useful either because their background concentrations were higher than resultant concentrations or pore water analyses were not available.

Based on the calculated Q_t, the continuous infiltration rate over the eight-acre area of the tailings is 6.4×10^{-11} feet per second (ft/s) (2.0×10^{-9} cm/s); the average annual rate is equal to 0.024 inches per year (in/yr) (0.06 cm/yr), or 0.4 percent of the average annual precipitation. While this method of calculating Q_t has inherent uncertainties (e.g., averages are used and geochemical attenuation is not considered), it indicates that the percolation of water through the tailings is very little, and is probably within the range estimated by Rush et al. (1982). Detailed mixing calculations to estimate Q_t are on file in the UMTRA Project Office, Albuquerque, New Mexico.

Tailings pore water samples were collected and analyzed from lysimeter 714 located at the east end of the pile (see Figure D.5.1) in September 1986 and March 1987 (Table D.5.23). Less than 500 milliliters could be obtained from the lysimeter each time, so only a select number of parameters could be analyzed. No pore water at all could be collected during October 1987 and January 1988 samplings. Since radionuclide analyses require one liter of water or more, radionuclide concentrations in the pore water could not be determined. In addition, since only a select number of constituents were analyzed, a cation/anion balance could not be accurately performed and the reliability of the results are uncertain. Finally, the pore water samples are highly sensitive to fluctuations in soil moisture content (responses to rainfall and evaporation); this seems to be reflected by the high variance in pore water parameters like chloride, potassium, nitrate, sulfate, TDS, and uranium.

Uranium mill tailings, buffer material, and contaminated windblown soils samples were collected from representative stockpiles at the Green River site in March 1989. The stockpiles for tailings, buffer material, and windblown soils are located near test pit 544, between monitor wells 588 and 561, and near test pit 577, respectively (see Figure D.5.1). The samples were used to determine the mobility of contaminants in the materials to be placed in the disposal cell. Batch leach and column extraction tests were conducted on the samples, and the batch solutions and column feed solutions were analyzed for all of the hazardous constiutents identified at the site (see Table D.5.27). Radionuclides were not analyzed because of the limited quantity of solution from the batch leach and column extraction tests.

Results show that, for all of the hazardous constiutents identified at the Green River site, except for uranium and vanadium, the extract concentrations from batch experiments using windblown soils are below the interim concentration limits proposed by NRC (see Table E.1.1). Concentrations of vanadium slightly exceed the NRC-proposed interim concentration of 0.09 mg/l, but are well below the observed range of maximum values from background groundwater samples beneath the disposal site (0.38 mg/l maximum). Uranium concentrations from the windblown extract are above both the interim concentration limit of 0.044 mg/l (which is EPA's established MCL) and the maximum observed value in groundwater of 0.146 mg/l. However, the column feed experiments show that uranium is attenuated by the buffer material to a concentration greater than one order of magnitude less than the feed concentration (from tailings solution). Based on the batch and column experiments, it can be assumed that the windblown soils are "clean" and are "buffer" material in addition to the clean select-fill buffer material placed in the bottom of the cell. With this assumption, travel of contaminants can be assumed to be from the base of the tailings (top of the windblown soils) through the base of the buffer materials.

Milling process

The Green River processing plant was operated from March 1958 to January 1961 (FBDU, 1981). Ore from uranium mines at Temple Mountain, Utah, was upgraded, and the ore concentrate was shipped by railroad to Rifle, Colorado, for further processing.

The uranium ore was sandstone loosely cemented with clay and asphaltic material, with part of the uranium intimately associated with carbonaceous minerals. After crushing and grinding, the ore was screened, with minus-35 mesh material going to flotation and the plus-35 mesh material joining the flotation concentration to form a carbonaceous concentrate. The flotation tailings were separated into sand and slime fractions. The sands were leached with acid, the leached slurry washed, and the spent sands discarded to the tailings area. The recovered slimes and pregnant solution were then joined with a portion of the initial slime fraction. Any excess acid was neutralized with ammonia. This mixed product plus the remainder of the primary slimes were then dewatered and dried for shipment to the Rifle, Colorado, processing plant.

D.5.2.9 Geochemical conditions

The presence of pyrite and organic matter in the Cedar Mountain Formation aquifer of the Green River site indicates that groundwater at the site is relatively reducing (DOE, 1988b). The Cedar Mountain Formation contains mudstones with occasional thin and discontinuous calcareous beds. Groundwater flow is controlled by fractures, joints, and faults, which are continuous through the upper middle portion of the stratum. Fracture surfaces in the unsaturated zone contain significant quantities of ferric oxyhydroxide, calcite, gypsum, and oxidized pyrite. The presence and movement of groundwater beneath the tailings impoundment is controlled by connected fractures. Strong, upward, vertical hydraulic gradients are prevalent through the entire saturated hydrostratigraphic sections.

Results of selected water-quality analyses of the Cedar Mountain Formation aquifer are provided in Table D.5.24. The monitor wells were sampled in May 1988 and the water-quality data collected during this period are representative of the aquifer. This groundwater generally is a sodium sulfate type and the TDS content is higher than 4500 mg/l. Monitor wells 562 and 813 are upgradient of the tailings impoundment; however, groundwater samples from these monitor wells have high concentrations of nitrate, sulfate, and TDS. Monitor well 701 is completed beneath the tailings impoundment and groundwater samples from this well are contaminated from tailings leachate. Concentrations of nitrate, ammonium, selenium, and macro-solutes are elevated above background. The groundwater remains buffered by limestone lenses within the aquifer.

Monitor wells 581 and 584 are downgradient from the tailings impoundment, and groundwater samples from these wells contain relatively low concentrations of nitrate and most other macro-solutes. Dissolved hydrogen sulfide occurs in monitor well 581, where field Eh measurements indicate relatively reducing conditions. Field alkalinity values recorded at monitor well 581 are relatively high, which may be the result of the oxidation of solid organic matter in the presence of hydrogen sulfide. Sulfate reduction is a bacterial reaction in which bacteria use the oxygen in SO_4^{2-} to oxidize organic matter to CO_2, which contributes to alkalinity, producing sulfide species. Sulfate reduction is represented by the following equation with pH values above 7:

$$SO_4^{2-} + 2C_{organic} + 2H_2O = HS^- + H^+ + 2HCO_3^- \qquad (1)$$

Petrographic analyses of core material taken near monitor well 581 show unoxidized, euhedral pyrite crystals in a matrix of solid organic matter, calcite, and quartz. Groundwater chemistry and mineralogy indicate that the Cedar Mountain Formation is relatively reducing downgradient of the tailings impoundment.

Uranium concentrations within the Cedar Mountain Formation decrease by several orders of magnitude within 600 feet downgradient of the tailings pile. For example, the concentration of uranium in groundwater samples from monitor well 701, completed beneath the tailings pile, is 2.69 mg/l, whereas the concentrations of uranium in groundwater samples from monitor wells 581 and 584 are below 0.001 mg/l. Figure D.5.24 shows the distribution of uranium in the upper-middle hydrostratigraphic unit at the Green River site.

The Cedar Mountain Formation consists of a Cretaceous marine limestone with lenses of sandstone and siltstone (see

Section D.5.2.3). Many secondary minerals are found on the fracture surfaces in the foundation bedrock beneath the disposal site. These include, but are not limited to, calcite, gypsum, and iron and magnesium oxides; pyrite is abundant on the fracture surfaces in the lower-middle sandstone unit.

Core samples collected above the water table contain fracture coatings consisting of calcite, gypsum, and iron and manganese oxides. The fractures have a higher permeability than the matrix permeability.

In general, the core samples collected below the water table indicate a considerable amount of carbonate is present, primarily as cement and vein filling, in the siltstones and sandstones. The sulfide (pyrite) content of the core samples ranged from 0.1 percent to 1.0 percent; in some cases oxidation to iron oxides affects the outer surfaces of individual grains.

The porosity appears to be low in the siltstones and moderate to low in the sandstones, and increases with increasing grain size. Fracture permeability probably has a significant role in fluid migration through these rocks. The fractures observed in the core samples are generally cemented with carbonate, and contain coatings of iron oxides. Fracture porosity is variable, but in general the existing fractures have moderate to low porosity.

Geochemical modeling using PHREEQE (Parkhurst et al., 1980) was performed to mix the tailings leachate with the ambient groundwater. Results of the modeling show that most heavy metals and trace elements have the potential to adsorb or precipitate from solution as a result of contact with the calcite and iron oxides in the aquifer. Where reducing conditions exist in the saturated zone and pyrite is present, the groundwater is predicted to be oversaturated with uraninite and amorphous UO_2, and precipitation of uranium would occur.

The solubility of uranium within the Cedar Mountain Formation aquifer may be controlled by precipitation of tetravalent uranium minerals such as uraninite and coffinite, by adsorption of uranium onto ferric oxyhydroxides and clay minerals, or by a combination of precipitation and adsorption processes. Cedar Mountain Formation groundwater is sufficiently reducing downgradient of the tailings pile to account for uraninite precipitation. Table D.5.25 shows the measured field Eh and the theoretical Eh required for Cedar Mountain Formation groundwater to be in equilibrium with uraninite. The measured field Eh value for monitor well 581 is more reducing than the theoretical Eh value calculated by the computer code PHREEQE. For monitor well 584, the measured Eh is approximately 0.02 volts more oxidizing than the theoretical Eh value required for uraninite equilibrium. The discrepancy between the field Eh and theoretical Eh values may be insignificant with respect to uraninite precipitation. Uranium concentrations, however, in groundwater samples from monitor wells 581 and 584 are in the low microgram/liter range.

Reduction of the uranyl ion (UO_2^{2+}) by aqueous sulfide forming poorly crystalline uraninite has been investigated by Mohogheghi and Goldhaber (1982). Their investigation shows that uranium concentrations greater than 2.75 ppm results in the precipitation of uraninite within 24 hours. Adsorption of hexavalent uranium may be necessary prior to chemical reduction. The partial pressures of hydrogen sulfide and carbon dioxide during their experiments were 4.3 x 10^{-2} atmospheres. Based on their experiments, concentrations of hydrogen sulfide within the Cedar Mountain Formation should provide conditions favorable for uraninite precipitation.

Speciation and saturation index calculations by PHREEQE can be made using either field Eh or calculated Eh values. Determining the most appropriate redox couple to use for model simulations is very difficult because internal disequilibrium exists between the redox couples (Lindberg and Runnells, 1984). Field Eh values were used as input for the PHREEQE simulations because they are intermediate to the calculated redox couples. It must be shown, however, that electron-transfer reactions taking place between the aqueous species of interest and the electrode surface are similar to reactions taking place between the aqueous species and the electron donor/acceptor present in the Cedar Mountain Formation aquifer. Small uncertainties in the measured electrode potentials and in the calculated Eh values from the redox couples may be important for simulating whether solubility control or adsorption is the major attenuation mechanism for uranium in the Cedar Mountain Formation aquifer. The Fe^{3+}/Fe^{2+} and Sato dissolved oxygen redox couples appear to be in close agreement with the measured Eh values for monitor wells 562, 701, and 813 upgradient from the tailings impoundment, whereas the HS^-/Rhombic S redox couple approximates measured Eh values for monitor wells 581 and 584 downgradient from the tailings impoundment. Berner (1963) has shown that the HS^-/Rhombic S couple is reversible for marine sediments and this redox couple is useful for approximating redox conditions in certain portions of the Cedar Mountain Formation aquifer where detectable concentrations of aqueous hydrogen sulfide are present.

The saturation indices for uraninite, coffinite, calcite, gypsum, pyrite, and amorphous $Fe(OH)_3$ with $PCO_2 = 10^{-2}$ atmospheres were computed by PHREEQE from analytical results (Tables D.5.23 and D.5.24) obtained from the groundwater analyses from monitor wells 562, 581, 584, 701, and 813. These modeling results are shown in Table D.5.26. Groundwater samples from monitor wells 562, 701, and 813 are undersaturated with respect to uraninite, coffinite, and pyrite and are oversaturated with respect to gypsum and amorphous $Fe(OH)_3$.

Cedar Mountain Formation groundwater is in equilibrium with calcite. Therefore, uranium is likely to be mobile in the Cedar Mountain Formation aquifer at the proposed disposal site and downgradient towards the existing tailings pile.

Petrographic analysis has shown the ubiquitous occurrence of calcite, gypsum, and ferric oxyhydroxide within the fractures. Uranium, stable as $UO_2(CO_3)_2^{2-}$ and $UO_2(CO_3)_3^{4-}$ complexes, is likely to be mobile in this portion of the aquifer. Conversely, groundwater is predicted to be oversaturated with respect to uraninite and pyrite downgradient of the tailings impoundment where uranium concentrations are below 0.001 mg/l. Pyrite occurs as euhedral crystals with no detectable oxidation coatings, indicating that oxidizing solutions are not presently in contact with the sediments. The analytical detection limit for total uranium is <0.001 mg/l and the saturation index values for uraninite and coffinite are maximum values. If the actual concentrations are less than 0.001 mg/l, then groundwater samples from monitor wells 581 and 584 could be undersaturated with respect to uraninite and coffinite. The occurrence of uraninite and coffinite in this portion of the Cedar Mountain Formation has not been established by petrographic techniques.

Solubility experiments conducted by Ryan and Rai (1983), however, show that $U(OH)_5^-$ may not be as strong a complex of U(IV) because no evidence for the predominance of $U(OH)_5^-$ was observed under alkaline pH conditions. In addition, thermochemical data (hydrolysis constant) for $U(OH)_5^-$ may be suspect (Bruno et al., 1987) and the stability fields for dissolved U(IV) species can be much larger than what are reported in the literature. This implies that the stability fields for U(IV) species may be much more restricted in nature.

In light of these concerns, additional speciation calculations which did not include $U(OH)_5^-$ in the database still show that Cedar Mountain Formation groundwater remains oversaturated with uraninite using analytical data from monitor well 581. Uranyl tricarbonate becomes the dominant solution species of uranium in the absence of $U(OH)_5^-$. Input Eh value is the dominant control, in addition to uranium concentrations, for calculating the saturation index of uraninite.

Adsorption of uranium onto ferric oxyhydroxides, clay minerals, and other adsorbents present in the Cedar Mountain Formation (DOE, 1988b) may partially account for the observed concentration decrease of uranium. Complete adsorption of uranium onto ferric oxyhydroxide under relatively oxidizing conditions, however, is inhibited by the formation of $UO_2CO_3^o$, $UO_2(CO_3)_2^{2-}$, and $UO_5(CO_3)_3^{4-}$ complexes (Hsi and Langmuir, 1985; Tripathy, 1984). Speciation calculations for uranium show that the hydrolysis species $U(OH)_5^-$ is the dominant uranium species predicted for groundwater samples from monitor well 581, whereas $UO_2(CO_3)_3^{4-}$ is the dominant species in groundwater samples for monitor well 584. Adsorption of uranium onto minerals such as goethite, amorphous $Fe(OH)_3$, and hematite may occur to a greater extent where uranium hydroxo complexes are more abundant than uranyl carbonato complexes (Hsi and Langmuir, 1985; Tripathy, 1984).

In nature, uranium can become chemically reduced and concentrated to form an ore deposit. Uranium roll-front deposits consist of naturally occurring ore-grade uranium and the geochemical environment of these deposits may be similar to that of the Cedar Mountain Formation. The ore deposits are formed by several geochemical processes including dissolution, chemical reduction, complexation, sorption, and precipitation. The Eh of groundwater in contact with the ore deposit is relatively reducing (Eh $\leq$-0.100 V) and dissolved uranium concentrations can vary from 0.001 to 2000 mg/l (Deutsch and Serne, 1984; Runnells and Lindberg, 1984; Chathan et al., 1981; Cowart and Osmond, 1980). Downgradient from the ore deposit, uranium concentrations are in the low mcg/l range under chemically reducing conditions. Uranium rollfront and tabular deposits are found throughout the world in different geologic strata. The Cedar Mountain Formation is chemically reducing and uranium is being attenuated downgradient from the tailings pile through geochemical processes. Hydrogen sulfide, pyrite, and solid organic matter occur in the Cedar Mountain Formation and these materials are chemical reducing agents for uranium and other metals. Generation of hydrogen sulfide within the Cedar Mountain Formation has been occurring for millions of years. Subsequently, long-term reducing conditions are established for this formation.

D.5.2.10 Groundwater use, value, and alternative supplies

Existing use and value

There are 15 registered wells in Township 21 South, Range 16 East (State of Utah, 1985). Thirteen of these wells are on the west side of the Green River; one well is on the east side of the river one mile northeast of the tailings site (Figure D.5.25). The final well, the Crystal Geyser well, is in the southeastern corner of Section 34, Township 21 South, Range 16 East on the east bank of the Green River. Most or all of these wells, except for Crystal Geyser, are shallow (less than 20 feet deep) and are completed in the Green River alluvium. Information was obtained regarding 10 of the 15 wells. The majority of the wells are not being used because of the poor quality of the water, disrepair of the wells, and the availability of better-quality water from the city of Green River. This is consistent with Rush et al. (1982) on groundwater use on a regional basis.

The reported past use of water from these wells was for watering gardens or livestock. Groundwater in the Green River area is not considered potable (Rush et al., 1982). The city of Green River provides water to residents on the eastern side of the Green River. The nearest resident to the tailings site hauls potable water from a coin-operated outlet in the city of Green River (Casper, 1985). In summary, there are no known uses of groundwater within the potentially affected hydrogeologic setting of the tailings site.

It is difficult to assign an absolute value to water resources, especially those of lesser quality. Qualitatively, it can be stated that the shallow groundwater affected by the Green River mill tailings has a very low value due to its origin in an area affected by the Mancos Shale and other shale and limestone deposits of the Cedar Mountain Formation. The Utah Division of Water Resources (DWR, 1975) states, "Water originating from this [Mancos Shale] formation has little value . . . ."

<u>Future use and value</u>

Future use of shallow groundwater for domestic consumption in the site area is not expected due to the poor natural quality and low yield of aquifers in the area. Groundwater in the area of Green River is not considered to be potable (Rush et al., 1982).

Drill stem tests have indicated that the relative ability of the shallow groundwater system to yield fluid during testing is small and permeability values are low (Rush et al., 1982). Other studies in the region also report a lack of groundwater resources. The water found during oil and gas drilling corroborates these reports (DWR, 1975):

> "Most all wells that were drilled contacted water, but the quality of this water has been such that it was not fit to drink."

The detrimental effects of the Mancos Shale on the availability of good-quality groundwater is one of the main factors limiting future development of groundwater in the area (DWR, 1976):

> "Groundwater development of fissured or fractured areas of the Mancos Formation has not been successful because most water located in fissures or by complete penetration into other strata has been of poor quality . . . ."

Present development of alluvial groundwater is limited because of natural and man-made degradation of the water, and these conditions will persist. The availability of better-quality water from the municipal supply has caused a decline in the use of alluvial groundwater. In spite of the poor water quality in the Brown's Wash alluvium and in the underlying shales and limestones of the Cedar Mountain Formation, water suitable for crop irrigation and livestock watering was located in a sandstone unit of the lower Cedar Mountain Formation beneath the tailings site (bottom hydrostratigraphic unit). The value of this potentially usable source of groundwater is very difficult to determine; however, an estimate of the value can be made by comparing the value of alternate sources of water for irrigation and stock watering. The city of Green River charges water users outside the city limits $23 for the first 6000 gallons per month, and $2 for each additional 1000 gallons per month (City of Green River, 1984).

The cost of municipally supplied water for users outside the city's limits is twice that for users within the city's limits. While groundwater obtained from the Buckhorn Conglomerate member of the Cedar Mountain Formation cannot replace current domestic supplies unless better-quality water can be found in this unit elsewhere, the value of municipally supplied water provides an upper limit for the value of the water available in these units. The ultimate value of the water in the Buckhorn Conglomerate will also be dependent upon the lateral extent of this unit, its recharge capacity, and the long-term availability of water from this unit.

In summary, the future usage of groundwater will be limited by the generally small supply and relatively poor quality of groundwater in the area, and the availability of a good quality municipal water supply.

Alternative supplies

The tailings have not affected any groundwater currently being used. Alternate water supplies include Green River water as currently supplied by the city of Green River, and commercial water supply (e.g., delivery by tanker).

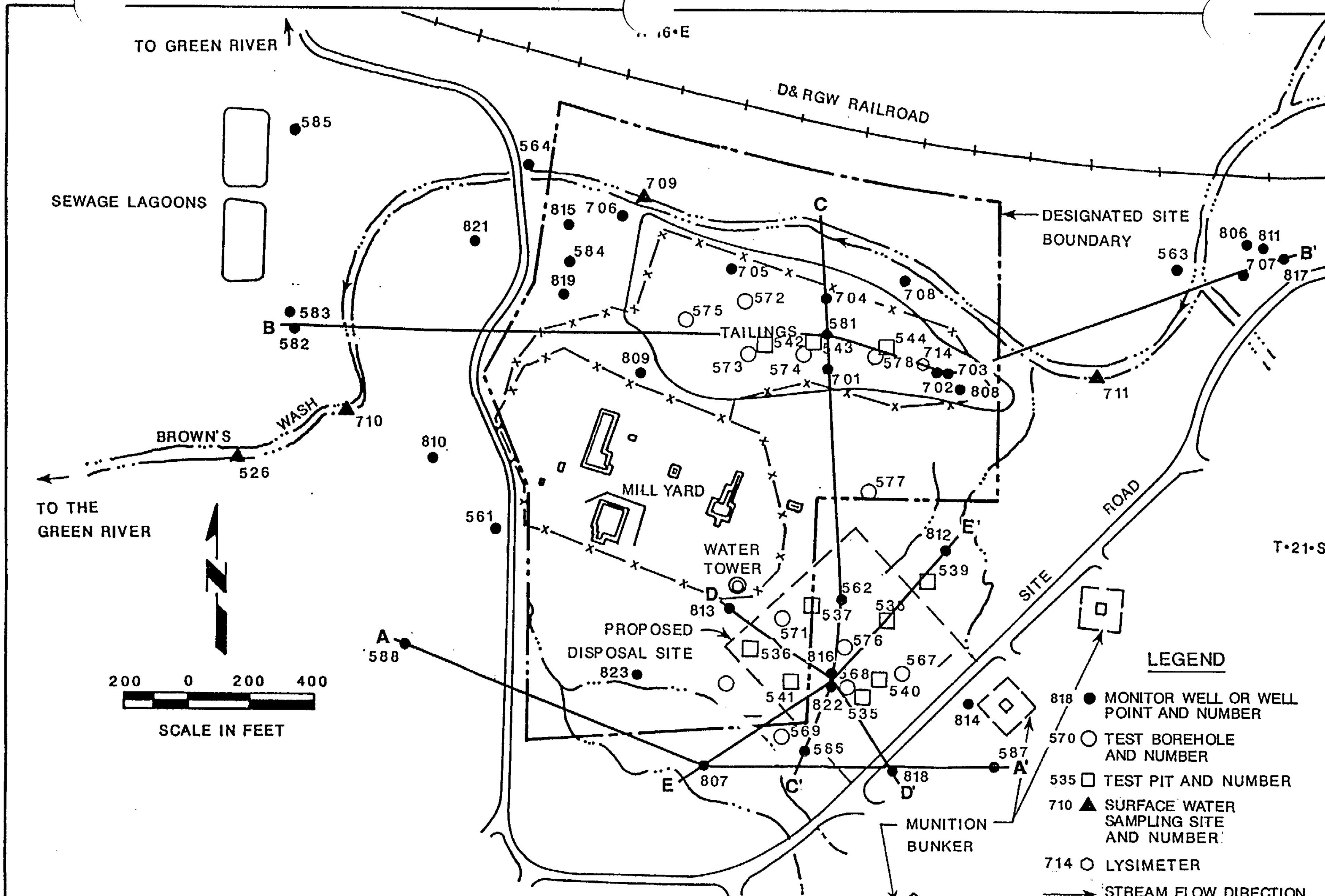
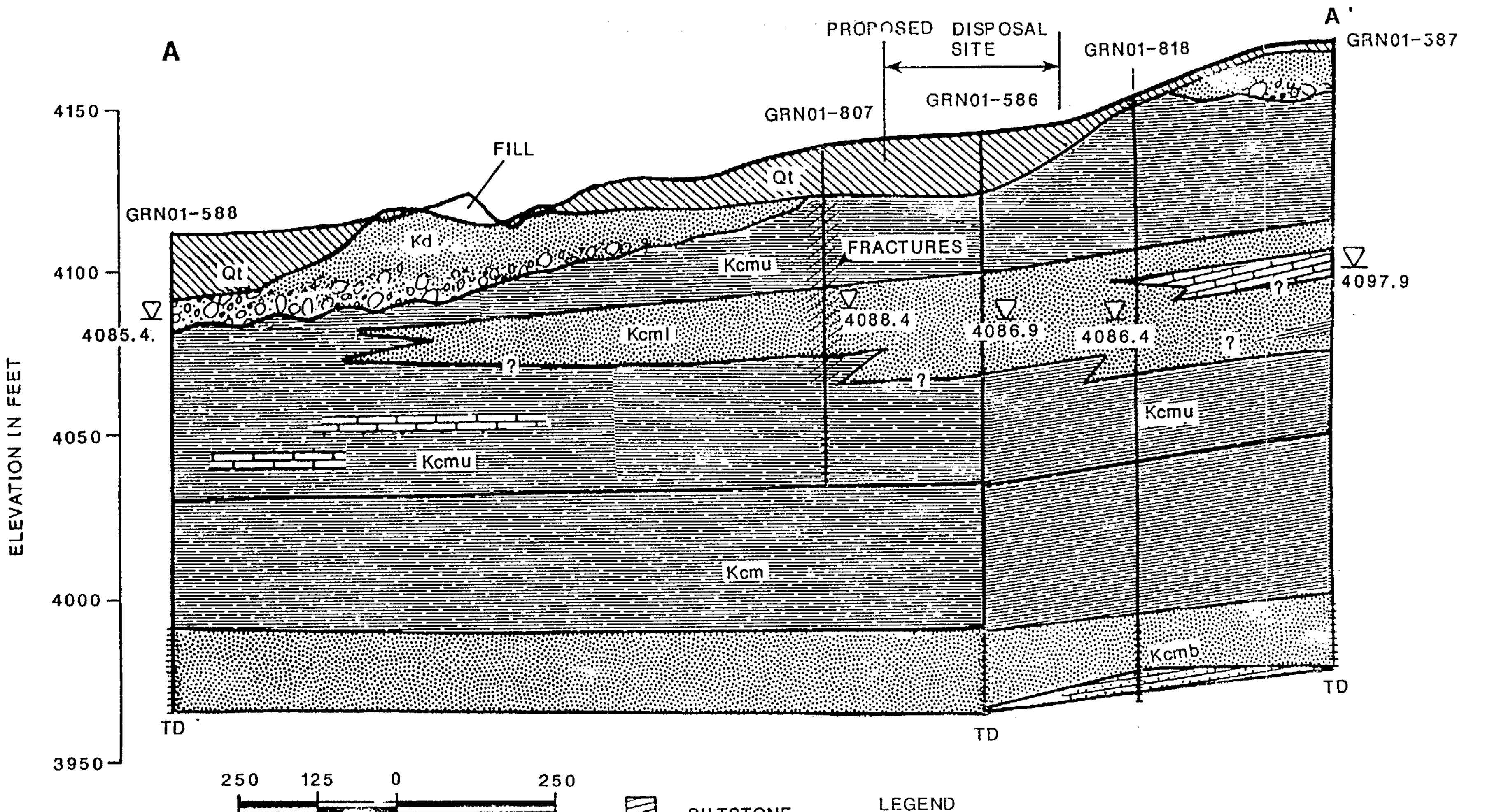


FIGURE D.5.1 LOCATIONS OF CROSS SECTIONS, MONITOR WELLS, LYSIMETER, ABANDONED BOREHOLES, TEST PITS, AND SURFACE WATER SAMPLING SITES, GREEN RIVER, UTAH, TAILINGS SITE



HORIZONTAL SCALE IN FEET
DATUM IS MEAN SEA LEVEL

4085.4 ▽ STATIC WATER LEVEL AND ELEVATION, 10/87.

CASING PERFORATIONS

TD = TOTAL DEPTH

LEGEND

SILTSTONE

SANDSTONE

CONGLOMERATE

SHALE OR MUDSTONE

LIMESTONE

RECENT ALLUVIUM

UNCONFORMITY

Qt – TERRACE SEDIMENTS

Kd – DAKOTA SANDSTONE

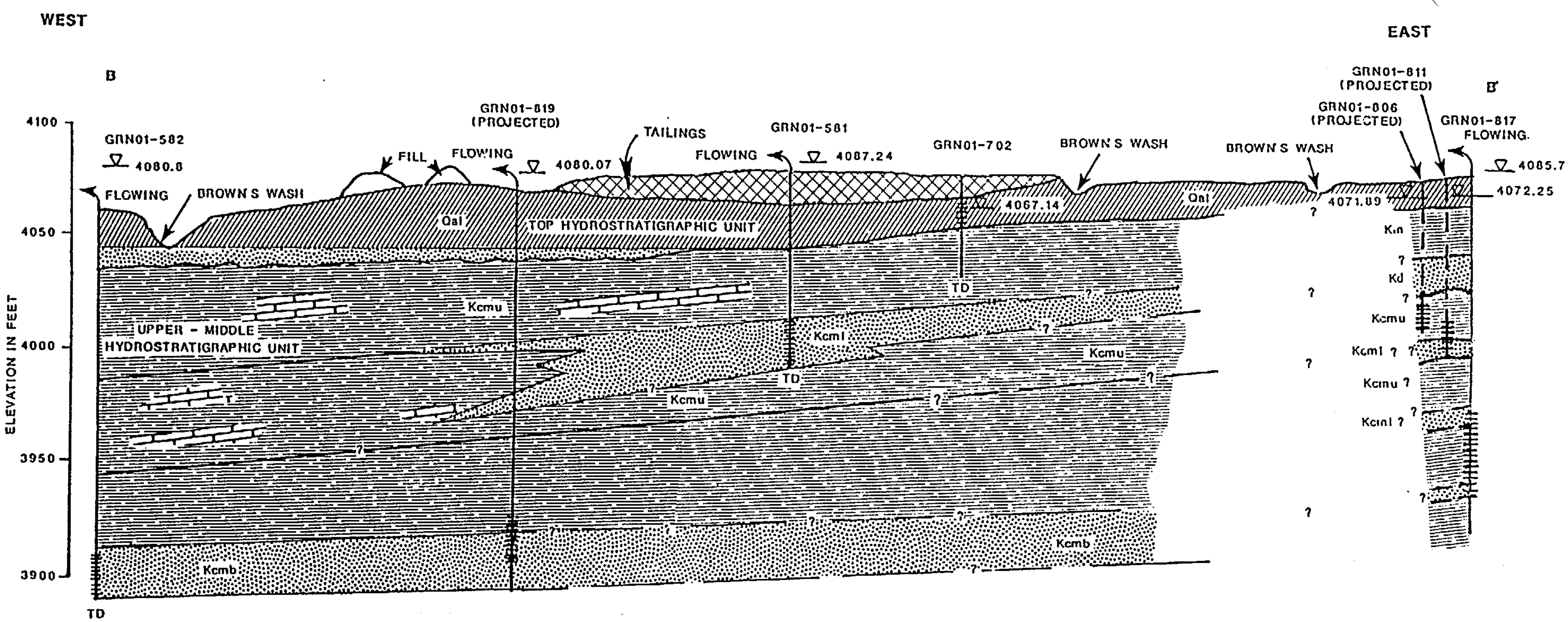
Kcmu – CEDAR MOUNTAIN FORMATION, UPPER MIDDLE UNIT

Kcml – CEDAR MOUNTAIN FORMATION, LOWER MIDDLE UNIT

Kcmb – CEDAR MOUNTAIN FORMATION BUCKHORN CONGLOMERATE MEMBER (BOTTOM UNIT)

NOTE: VERTICAL EXAGGERATIO

FIGURE D.5.2 HYDROGEOLOGICAL CROSS SECTION A–A', GREEN RIVER, UTAH, TAILINGS SITE



LEGEND

360 180 0 360

HORIZONTAL SCALE IN FEET
DATUM IS MEAN SEA LEVEL

4085.8 ▽ STATIC WATER LEVEL AND ELEVATION, 10/87

CASING PERFORATIONS

TD = TOTAL DEPTH

SANDSTONE

SHALE OR MUDSTONE

LIMESTONE

RECENT ALLUVIUM

UNCONFORMITY

Qal – RECENT ALLUVIUM

Km – MANCOS SHALE

Kd – DAKOTA SANDSTONE

Kcmu – CEDAR MOUNTAIN FORMATION, UPPER MIDDLE UNIT

Kcml – CEDAR MOUNTAIN FORMATION, LOWER MIDDLE UNIT

Kcmb – CEDAR MOUNTAIN FORMATION BUCKHORN CONGLOMERATE MEMBER (BOTTOM UNIT)

NOTE: VERTICAL EXAGGERATION X 5

FIGURE D.5.3
HYDROGEOLOGICAL CROSS SECTION B–B'
GREEN RIVER, UTAH, TAILINGS SITE

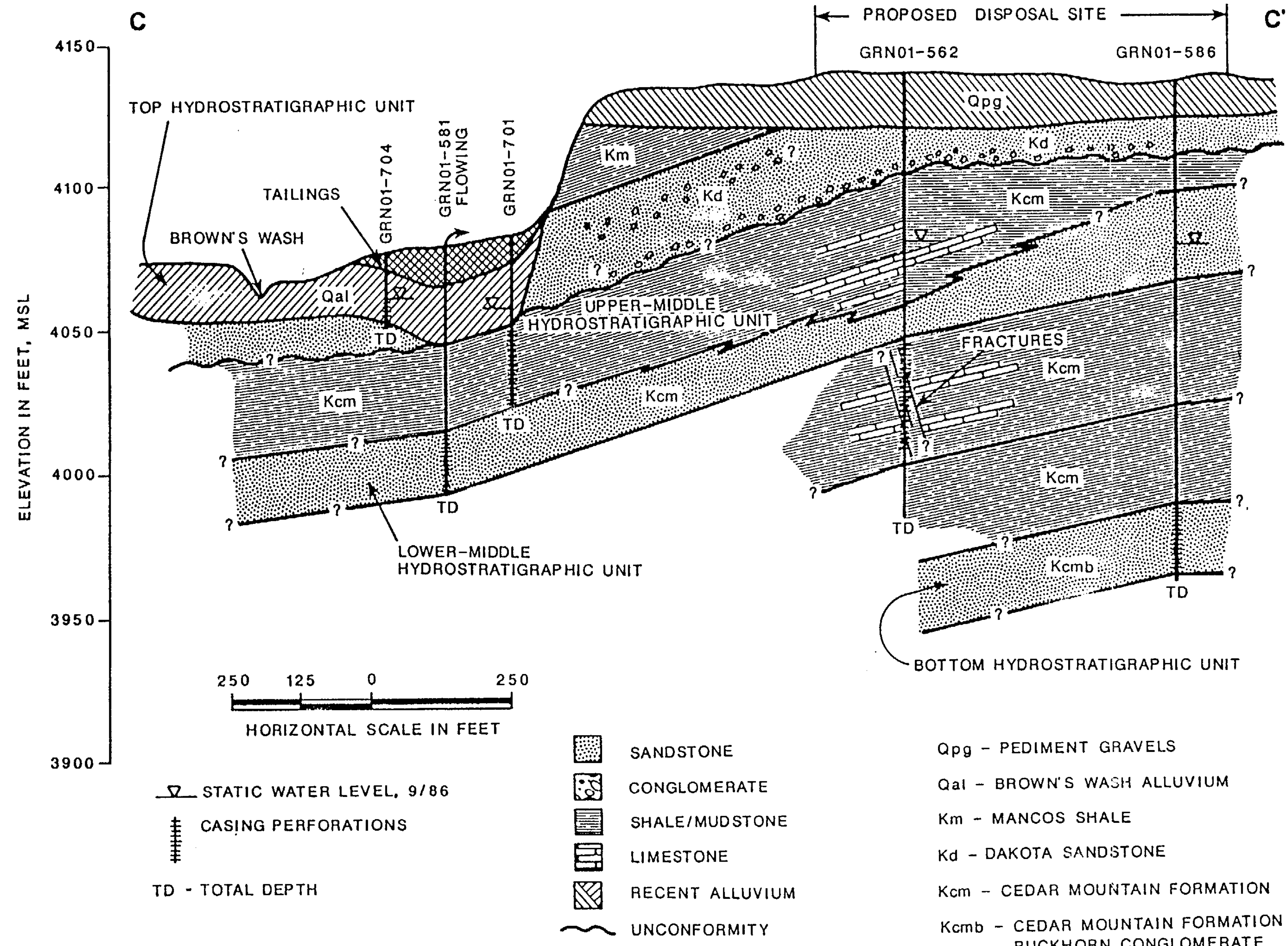
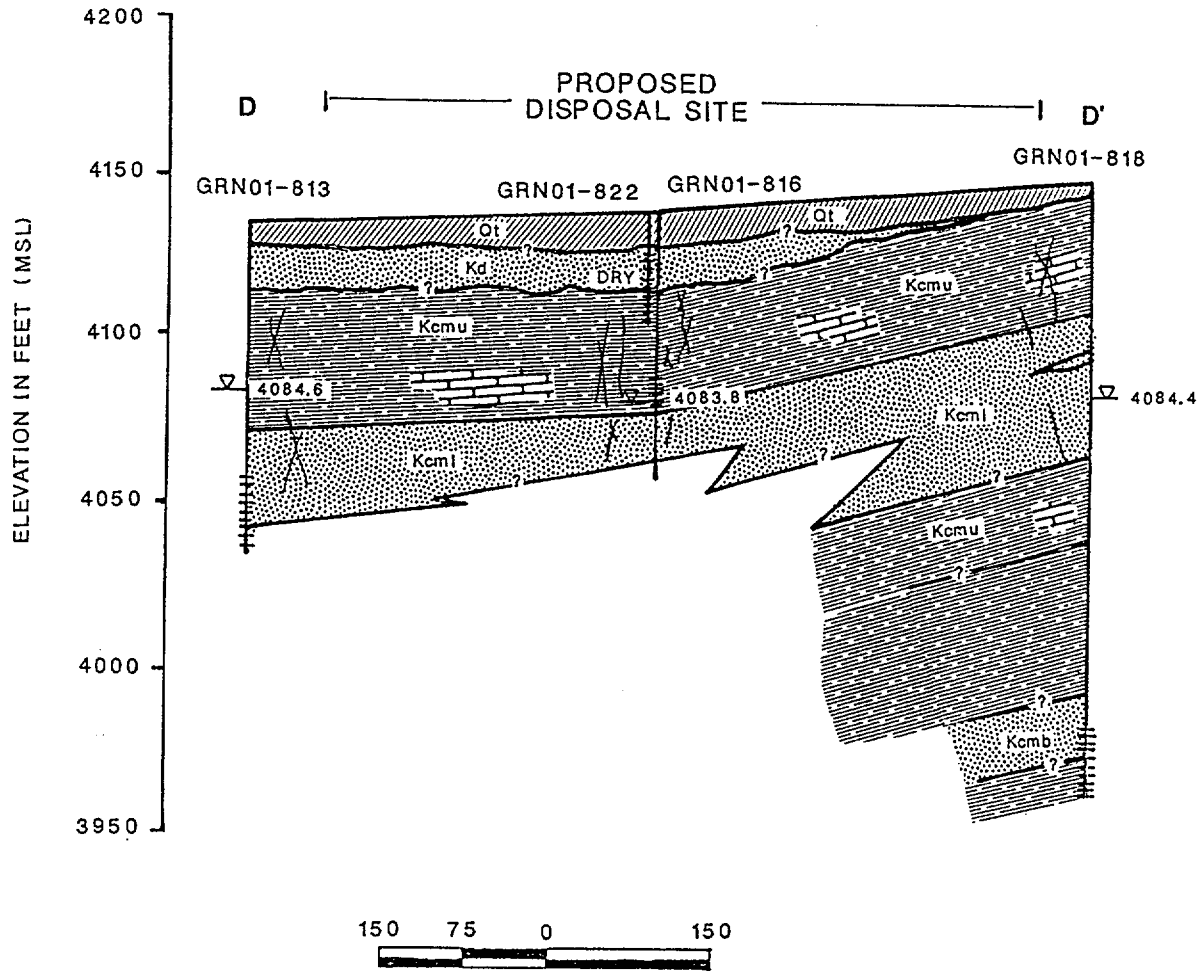


FIGURE D.5.4 HYDROGEOLOGIC CROSS SECTION C–C', GREEN RIVER TAILINGS SITE



HORIZONTAL SCALE IN FEET
DATUM IS MEAN SEA LEVEL

LEGEND

- SANDSTONE OR SILTSTONE
- SHALE OR MUDSTONE
- LIMESTONE
- RECENT ALLUVIUM
- UNCONFORMITY
- FRACTURES

Qt - TERRACE SEDIMENTS

Kd - DAKOTA SANDSTONE

Kcmu - CEDAR MOUNTAIN FORMATION, UPPER MIDDLE UNIT

Kcml - CEDAR MOUNTAIN FORMATION, LOWER MIDDLE UNIT

Kcmb - CEDAR MOUNTAIN FORMATION BUCKHORN CONGLOMERATE MEMBER (BOTTOM UNIT)

4084.4 ▽ STATIC WATER LEVEL AND ELEVATION, 10/87

CASING PERFORATIONS

TD - TOTAL DEPTH

NOTE: VERTICAL EXAGGERATION X 3

FIGURE D.5.5
HYDROGEOLOGICAL CROSS SECTION D-D'
GREEN RIVER, UTAH, TAILINGS SITE

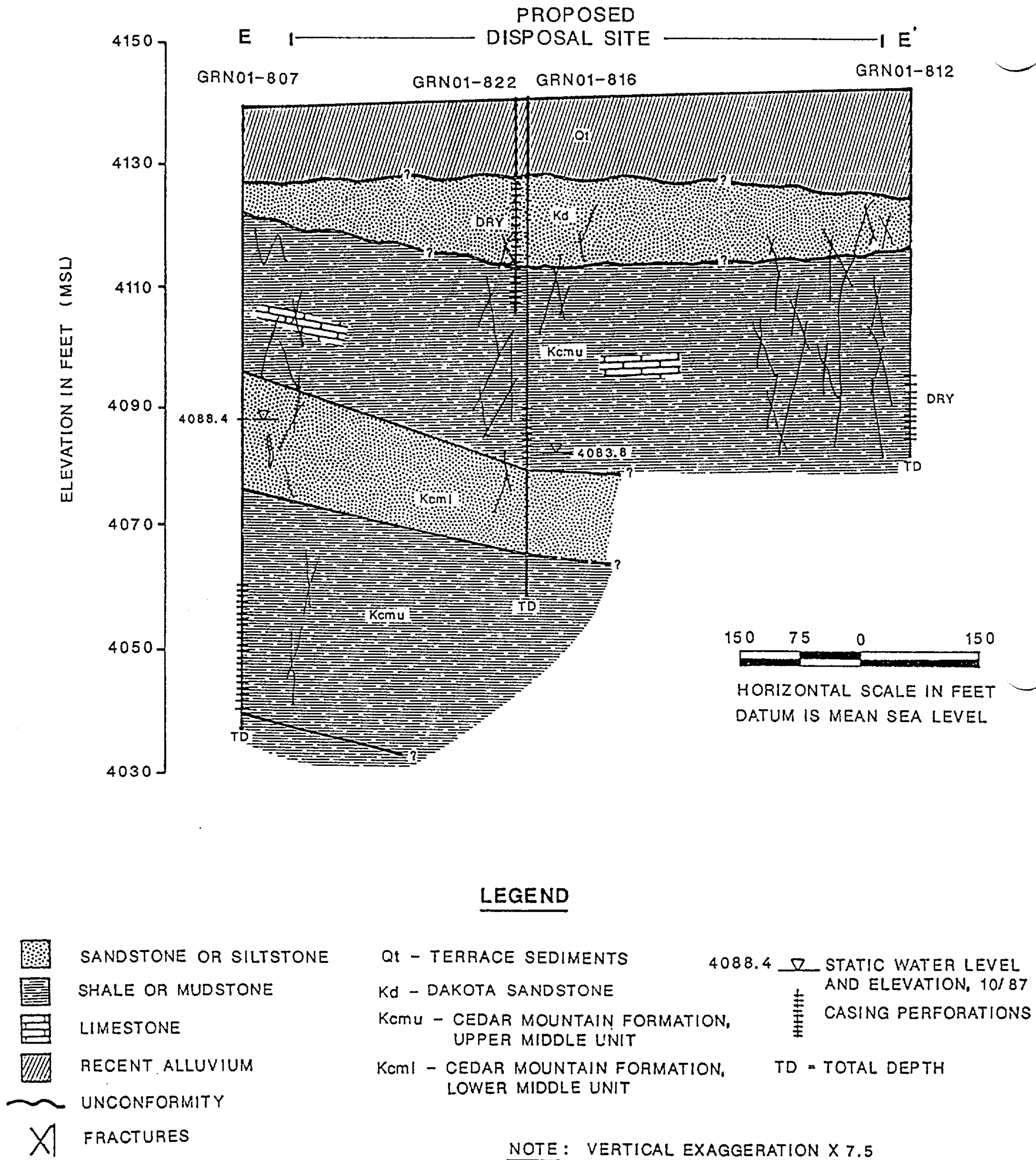


FIGURE D.5.6
HYDROGEOLOGICAL CROSS SECTION E-E '
GREEN RIVER, UTAH, TAILINGS SITE

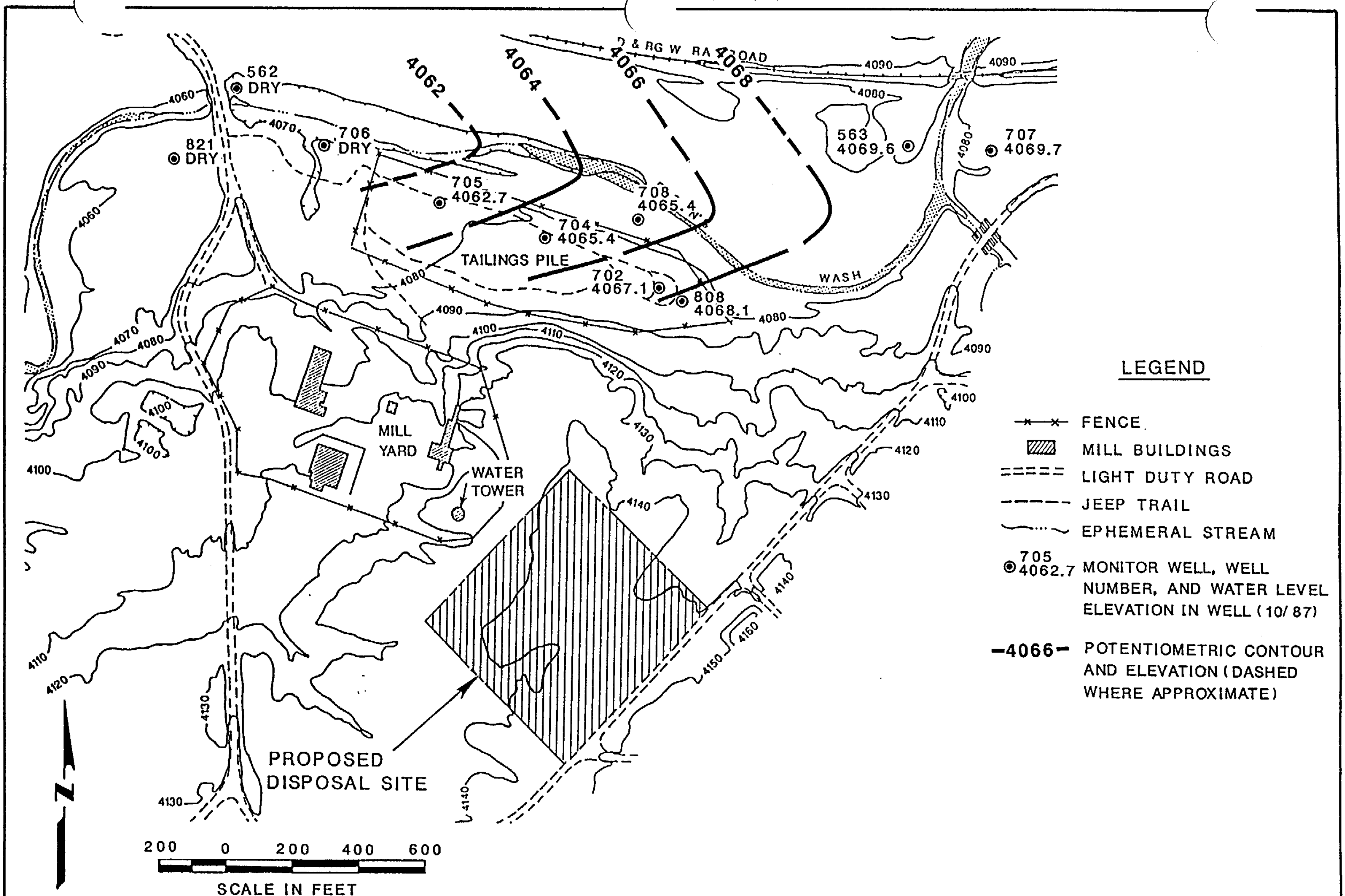


FIGURE D.5.7

WATER TABLE CONTOUR MAP AND MONITOR WELLS, TOP HYDROSTRATIGRAPHIC UNIT, GREEN RIVER, UTAH, TAILINGS SITE, OCTOBER, 1987

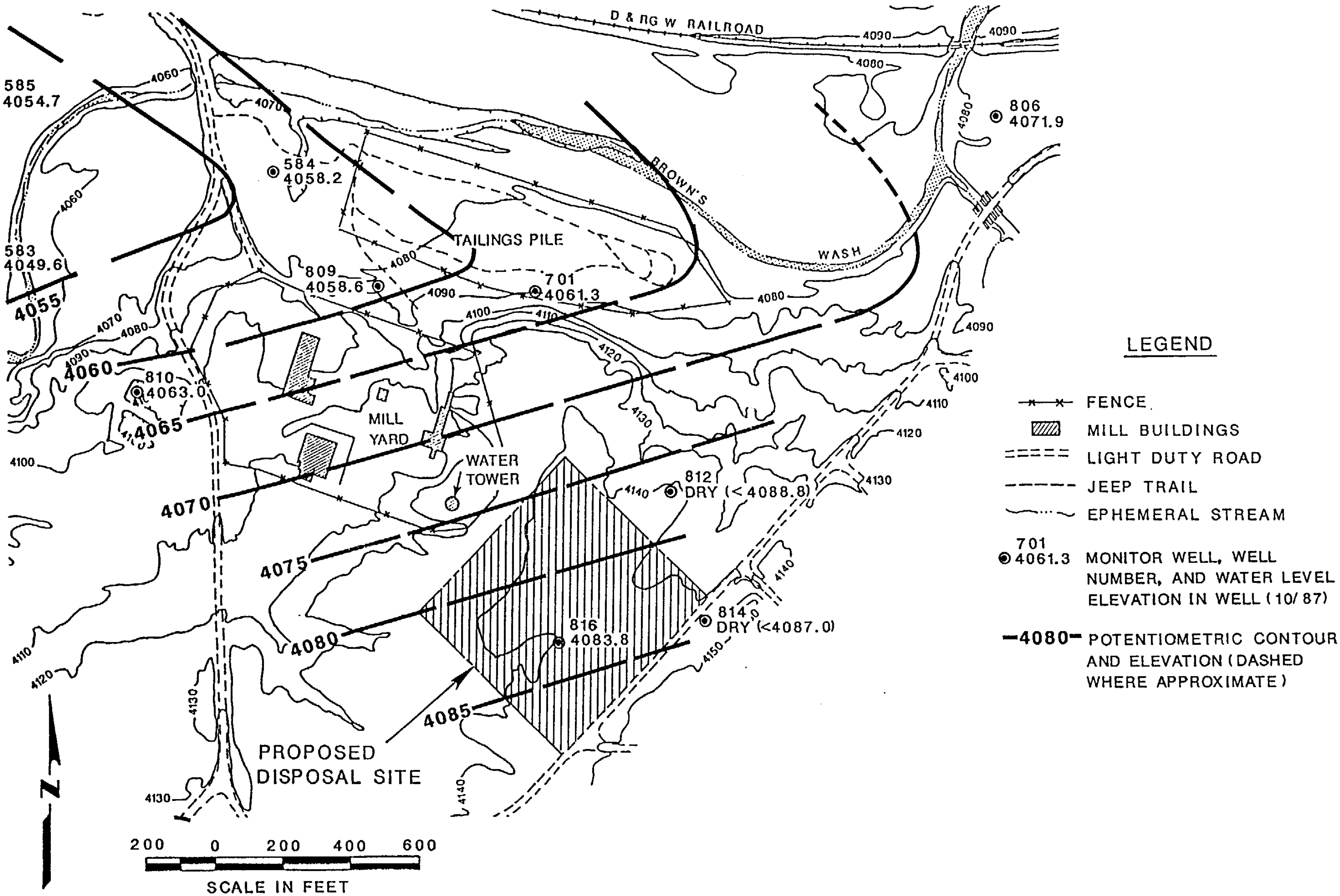


FIGURE D.5.8

P(NTIOMETRIC CONTOUR MAP AND MONIT(WELLS, UPPER - MIDDLE HYDROSTRATIG(HIC UNIT, GREEN RIVER, UTAH, AILINGS SITE, OCTOBER, 1987

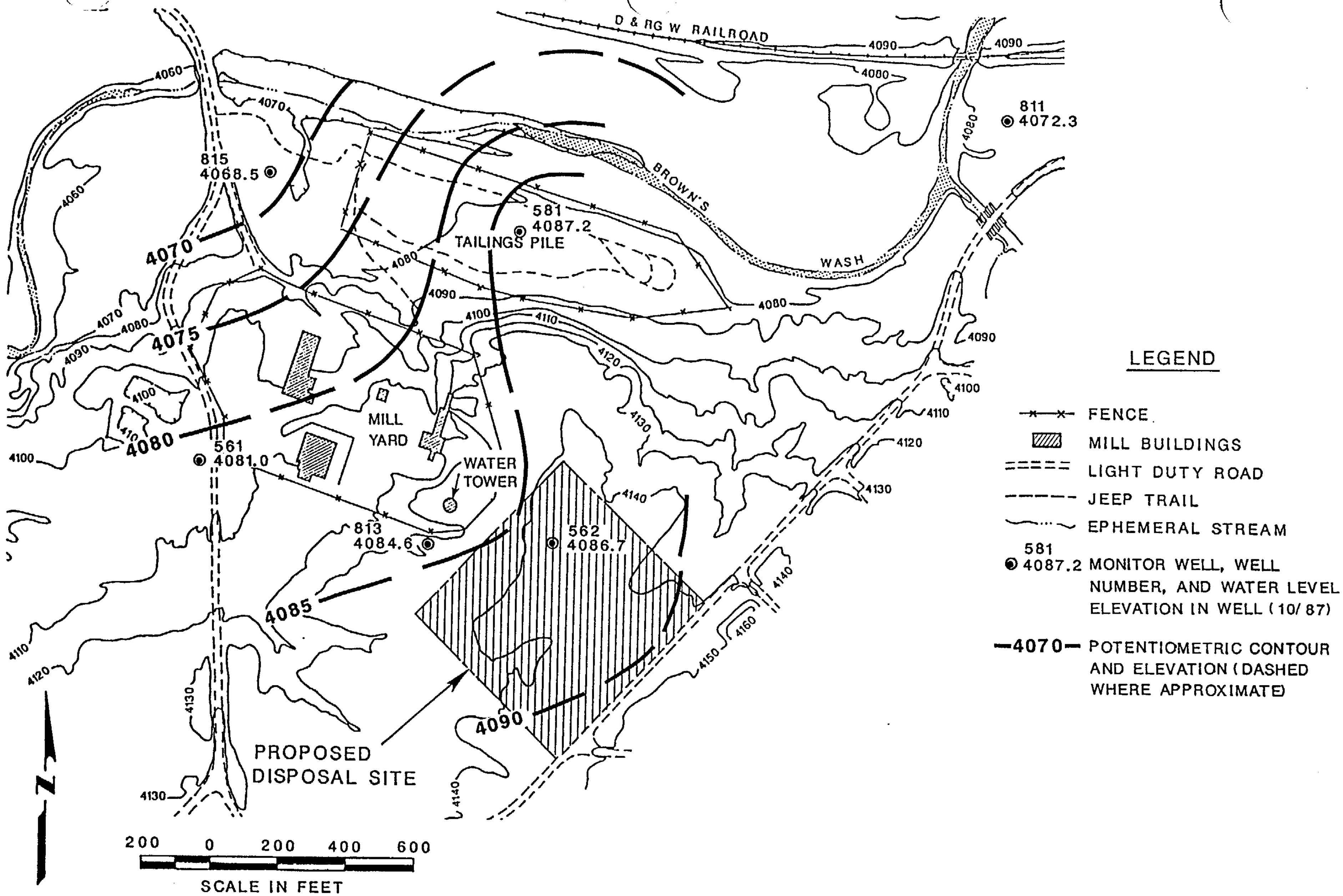


FIGURE D.5.9

POTENTIOMETRIC CONTOUR MAP AND MONITOR WELLS, LOWER - MIDDLE HYDROSTRATIGRAPHIC UNIT, GREEN RIVER, UTAH, TAILINGS SITE, OCTOBER, 1987

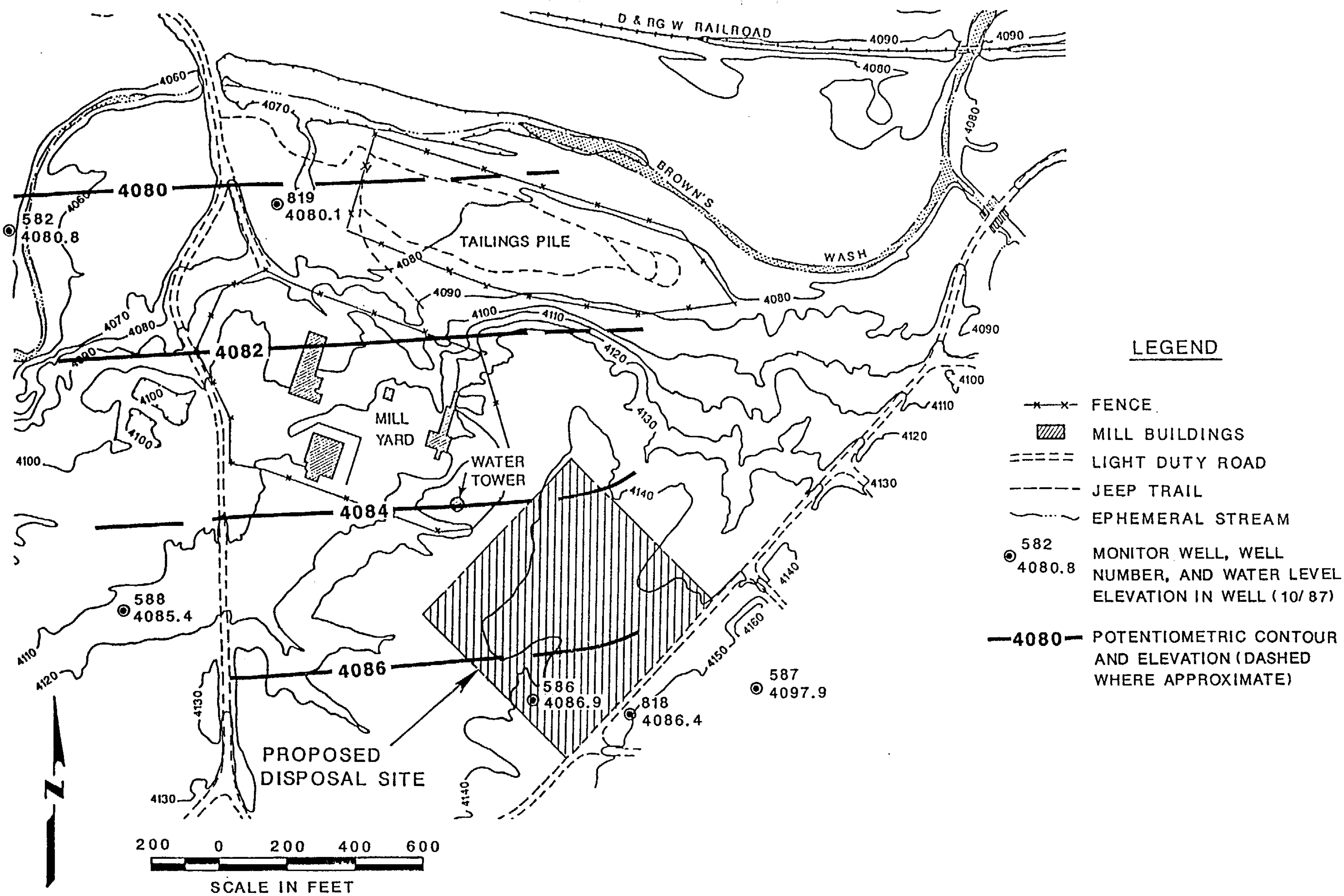
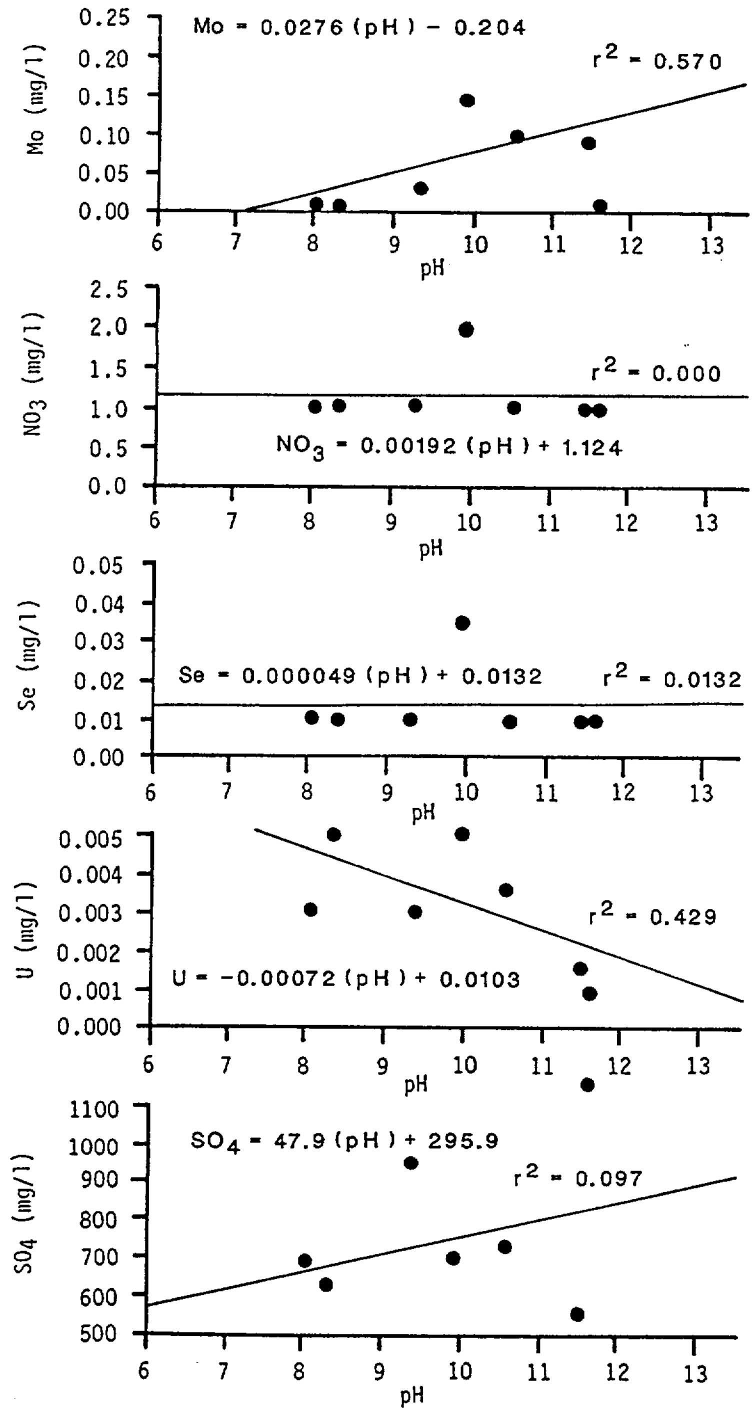


FIGURE D.5.10

POTENTIOMETRIC CONTOUR MAP AND MONITOR WELLS, BOTTOM HYDROSTRATIGRAPHIC UNIT, GREEN RIVER, UTAH, TAILINGS SITE, OCTOBER, 1987



pH	Molybdenum (mg/l)
8.10	<0.01
8.30	<0.01
9.35	0.03
9.92	0.14
10.51	0.10
11.49	0.09
11.61	<0.10

pH	Nitrate (mg/l)
8.10	<1
8.30	<1
9.35	<1
9.92	2
10.51	<1
11.49	<1
11.61	<1

pH	Selenium (mg/l)
8.10	<0.01
8.30	<0.01
9.35	<0.01
9.92	0.036
10.51	<0.01
11.49	<0.01
11.61	<0.01

pH	Uranium (mg/l)
8.10	<0.003
8.30	0.005
9.35	<0.003
9.92	0.005
10.51	0.0036
11.49	0.0015
11.61	<0.001

pH	Sulfate (mg/l)
8.10	690
8.30	620
9.35	950
9.92	700
10.51	720
11.49	540
11.61	1170

FIGURE D.5.11

PLOTS OF pH vs. MOLYBDENUM, NITRATE, SELENIUM, URANIUM, AND SULFATE FOR BOTTOM UNIT BACKGROUND MONITOR WELLS 586, 587, AND 818

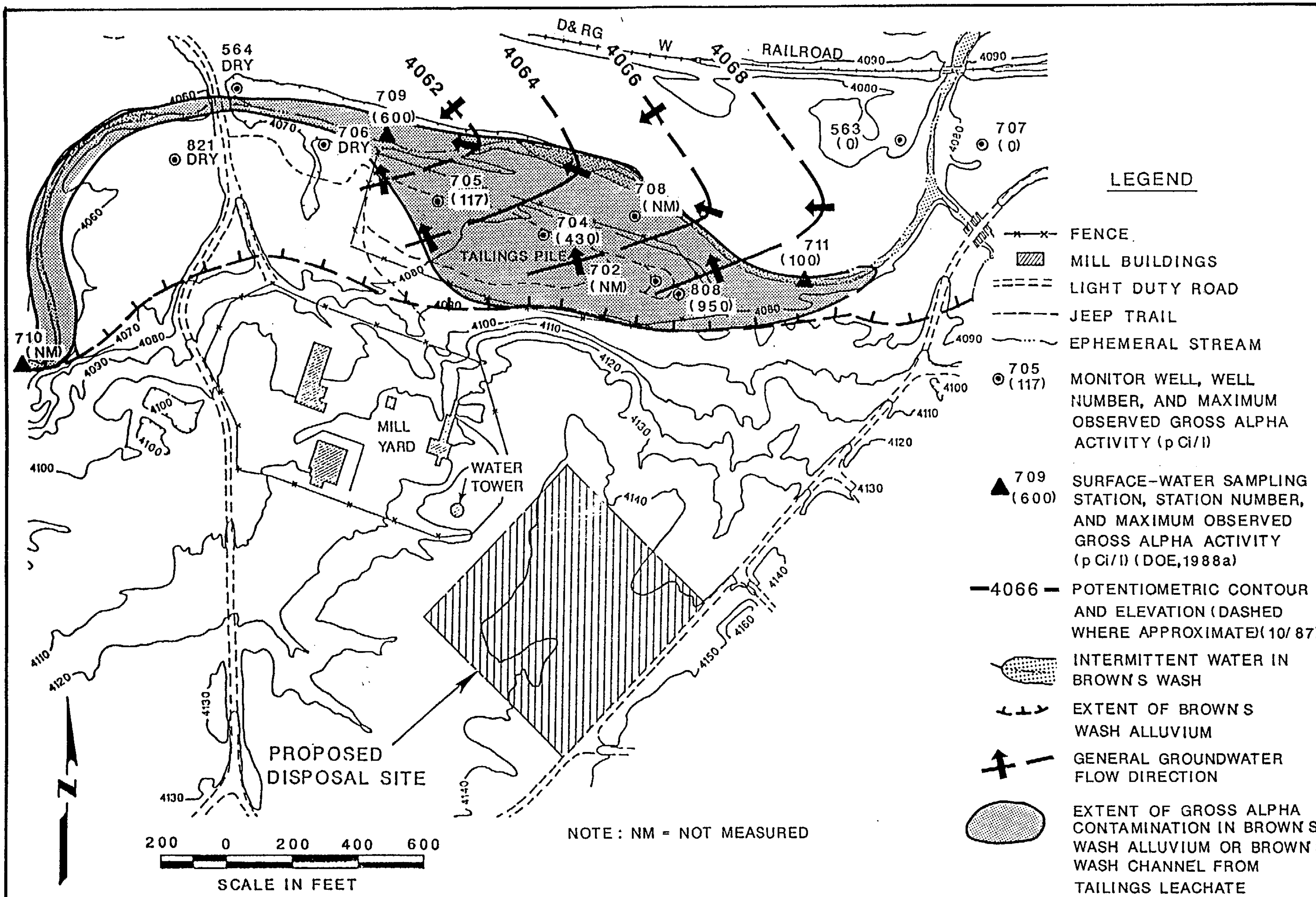


FIGURE D.5.12
MAXIMUM OBSERVED ACTIVITIES AND EXTENT OF GROSS ALPHA CONTAMINATION IN THE TOP HYDROSTRATIGRAPHIC UNIT, GREEN RIVER, UTAH, TAILINGS SITE

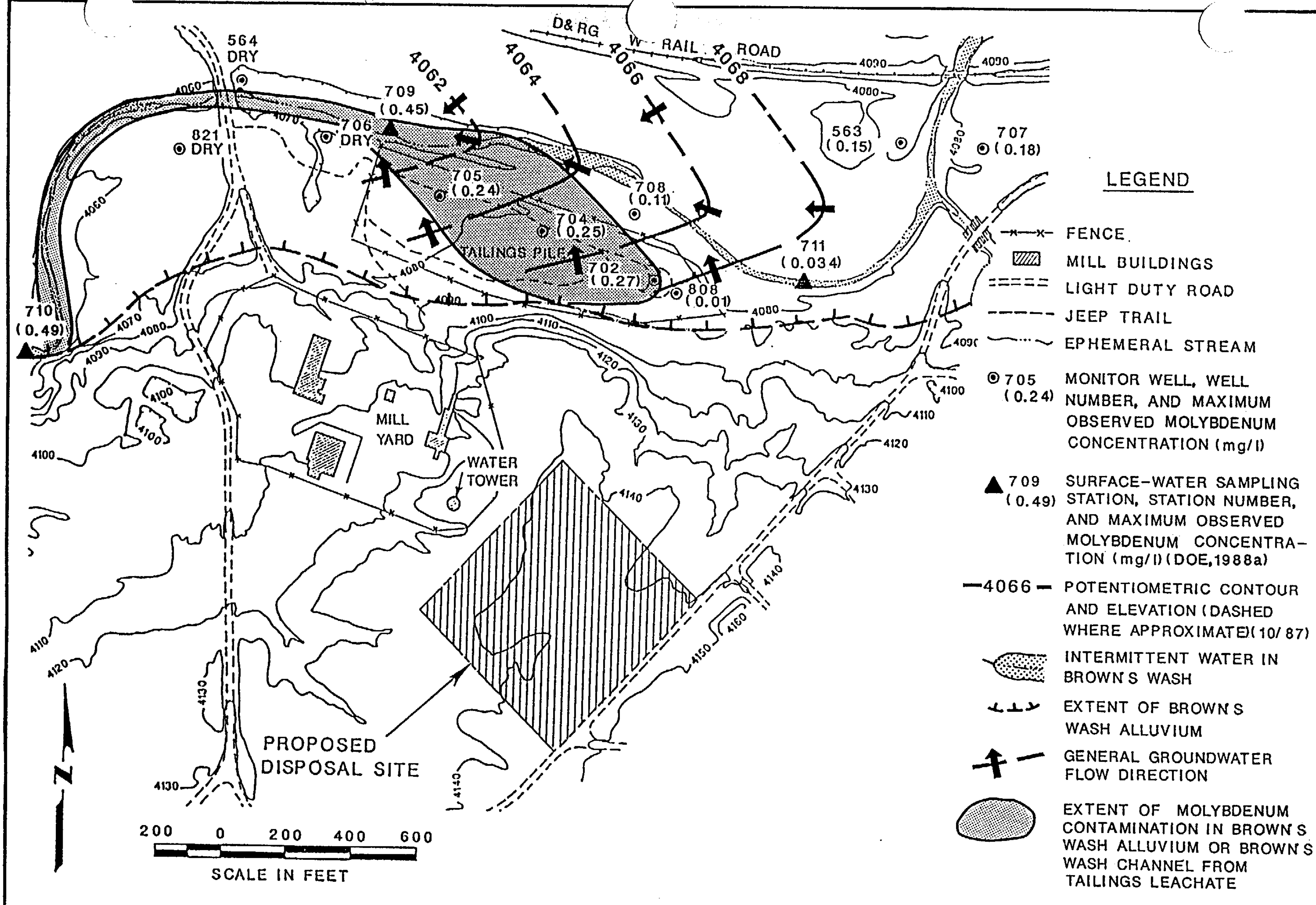


FIGURE D.5.13
MAXIMUM OBSERVED CONCENTRATIONS AND EXTENT OF MOLYBDENUM CONTAMINATION IN THE TOP HYDROSTRATIGRAPHIC UNIT, GREEN RIVER, UTAH, TAILINGS SITE

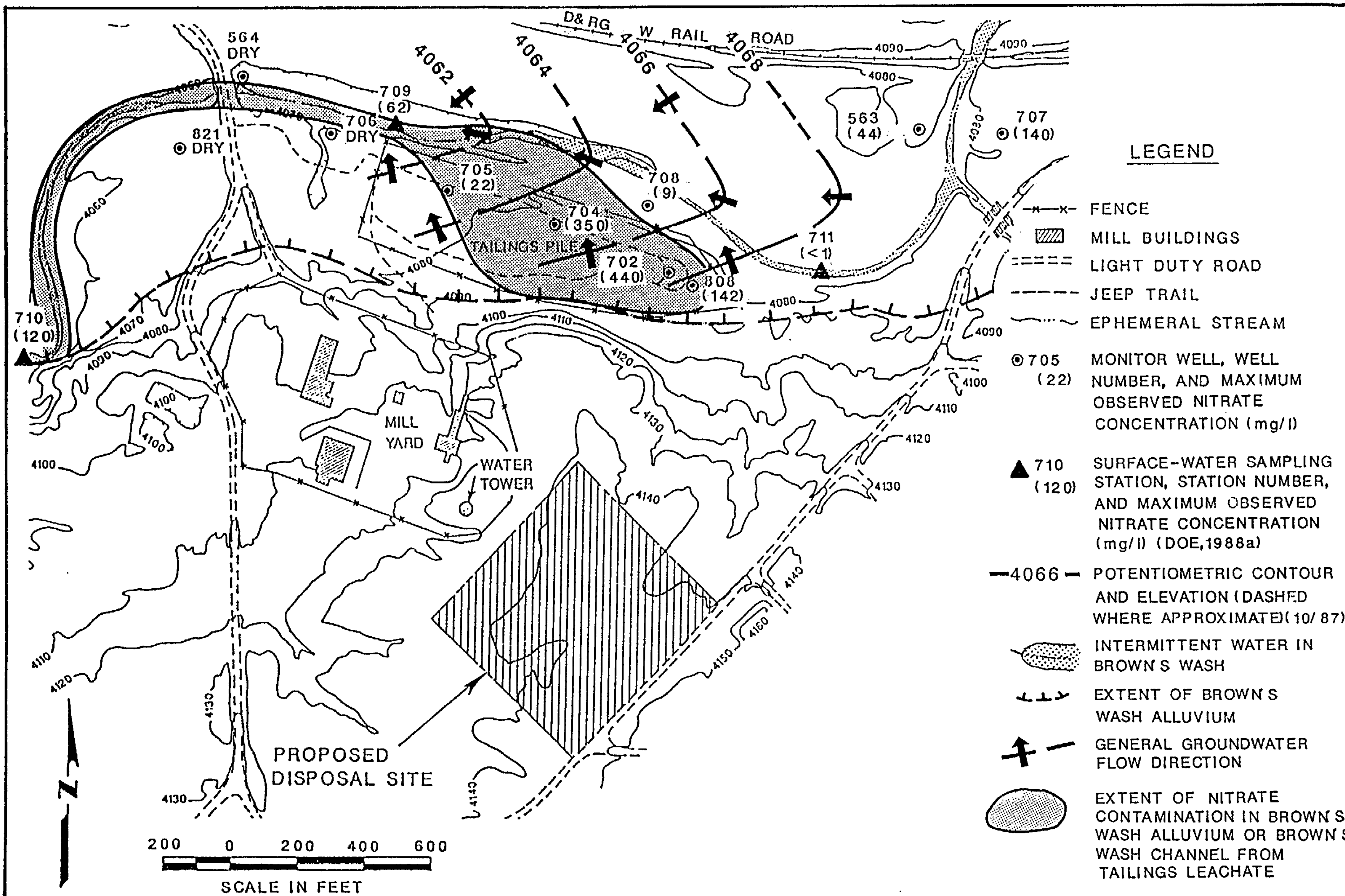


FIGURE D.5.14

MAXIMUM OBSERVED CONCENTRATIONS AND EXTENT OF NITRATE CONTAMINATION IN T... TOP HYDROSTRATIGRAPHIC UNIT ...REEN RIVER, UTAH, TAILINGS SITE

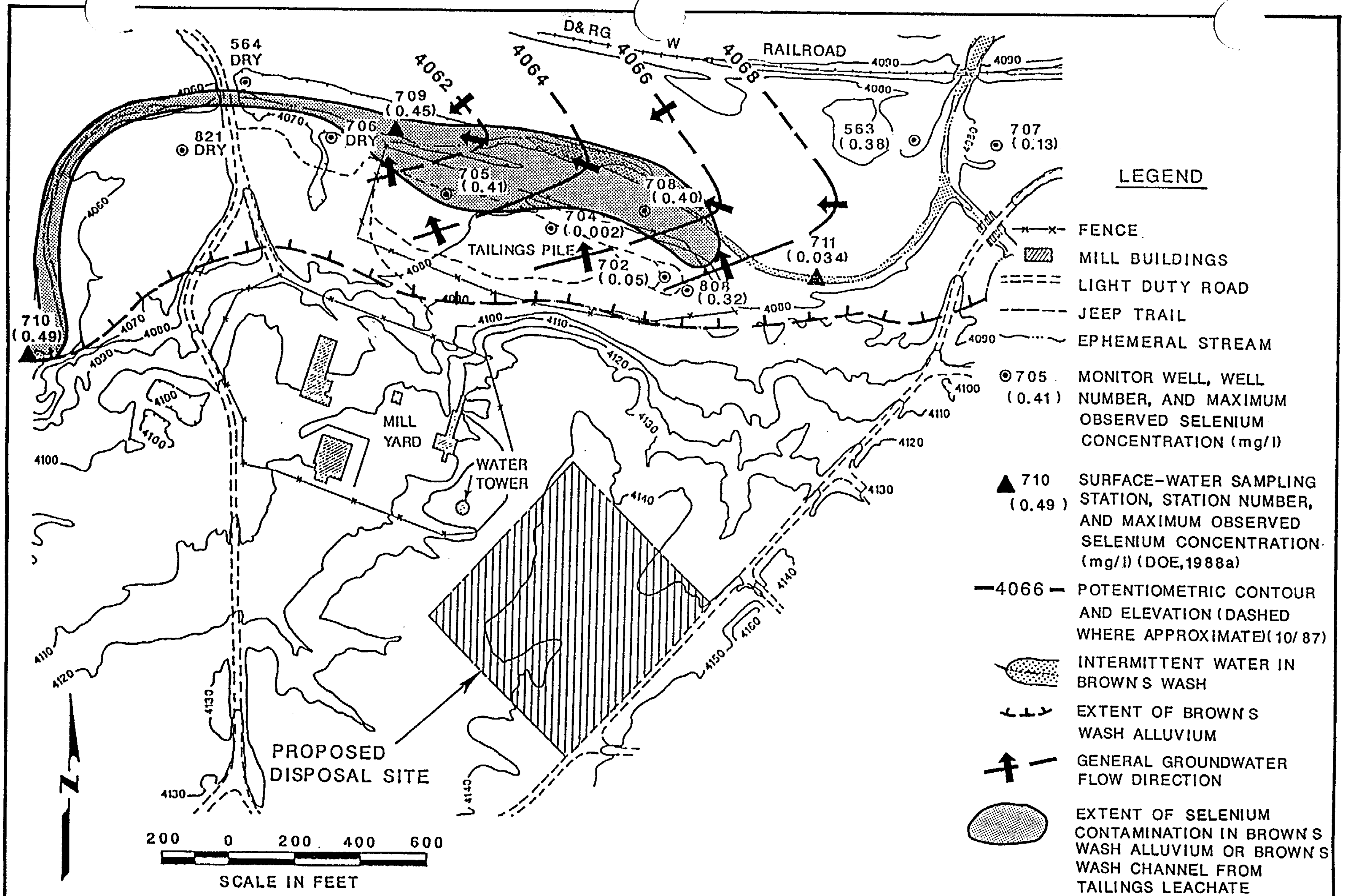


FIGURE D.5.15
MAXIMUM OBSERVED CONCENTRATIONS AND EXTENT OF SELENIUM CONTAMINATION IN THE TOP HYDROSTRATIGRAPHIC UNIT, GREEN RIVER, UTAH, TAILINGS SITE

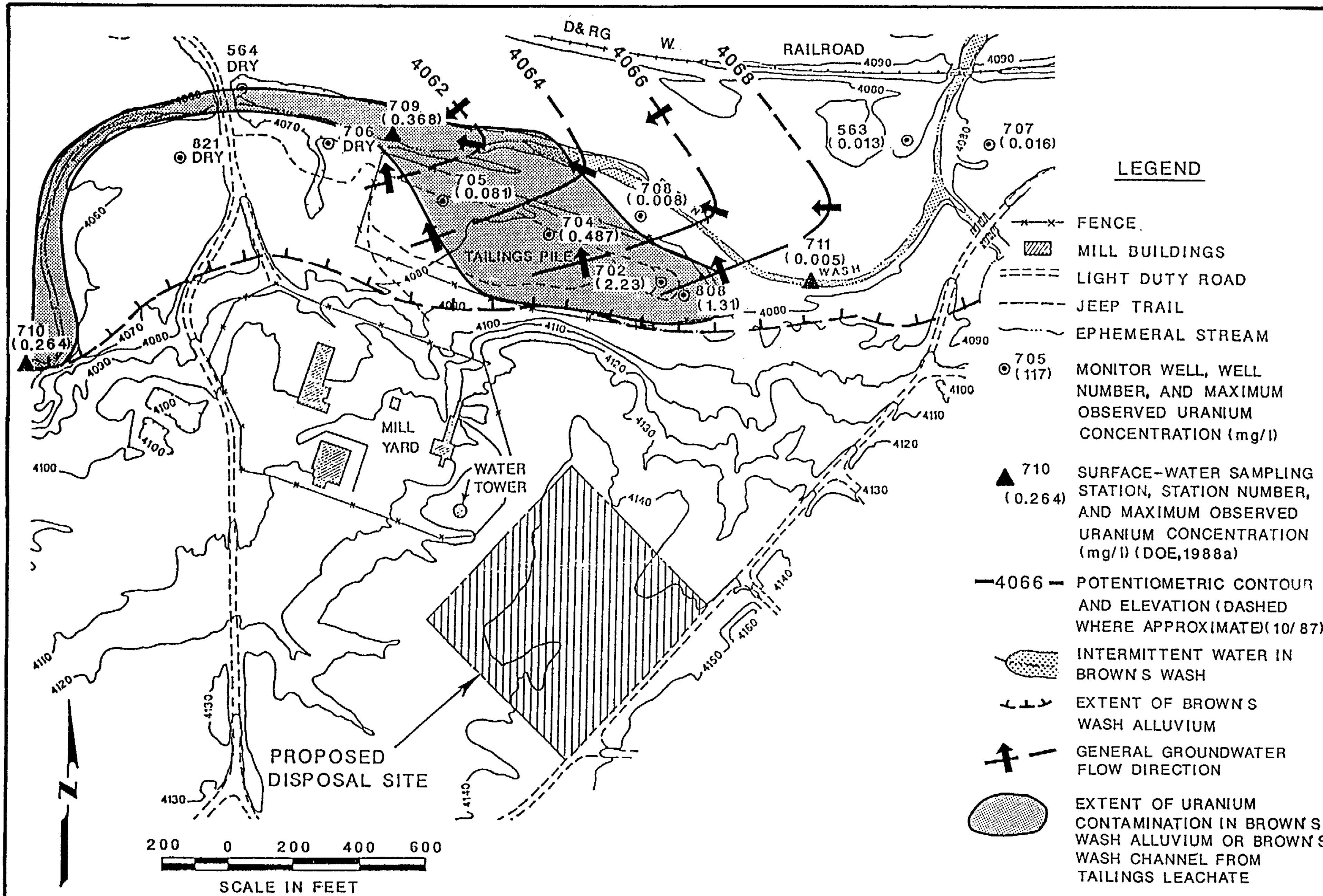


FIGURE D.5.16
MAXIMUM OBSERVED CONCENTRATIONS AND EXTENT OF URANIUM CONTAMINATION IN THE TOP HYDROSTRATIGRAPHIC UNIT REEN RIVER, UTAH, TAILINGS SITE

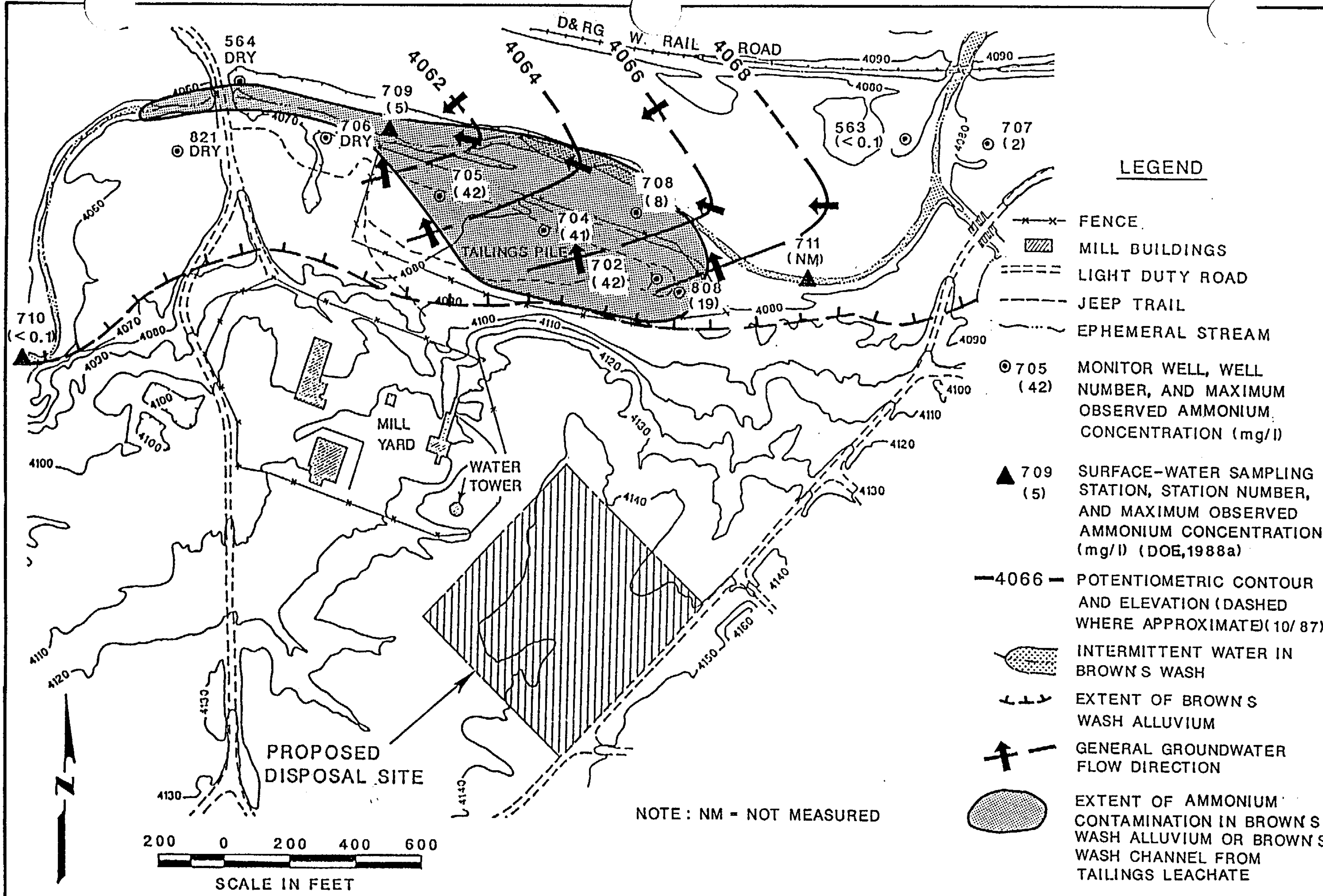


FIGURE D.5.17
MAXIMUM OBSERVED CONCENTRATIONS AND EXTENT OF AMMONIUM CONTAMINATION IN THE TOP HYDROSTRATIGRAPHIC UNIT, GREEN RIVER, UTAH, TAILINGS SITE

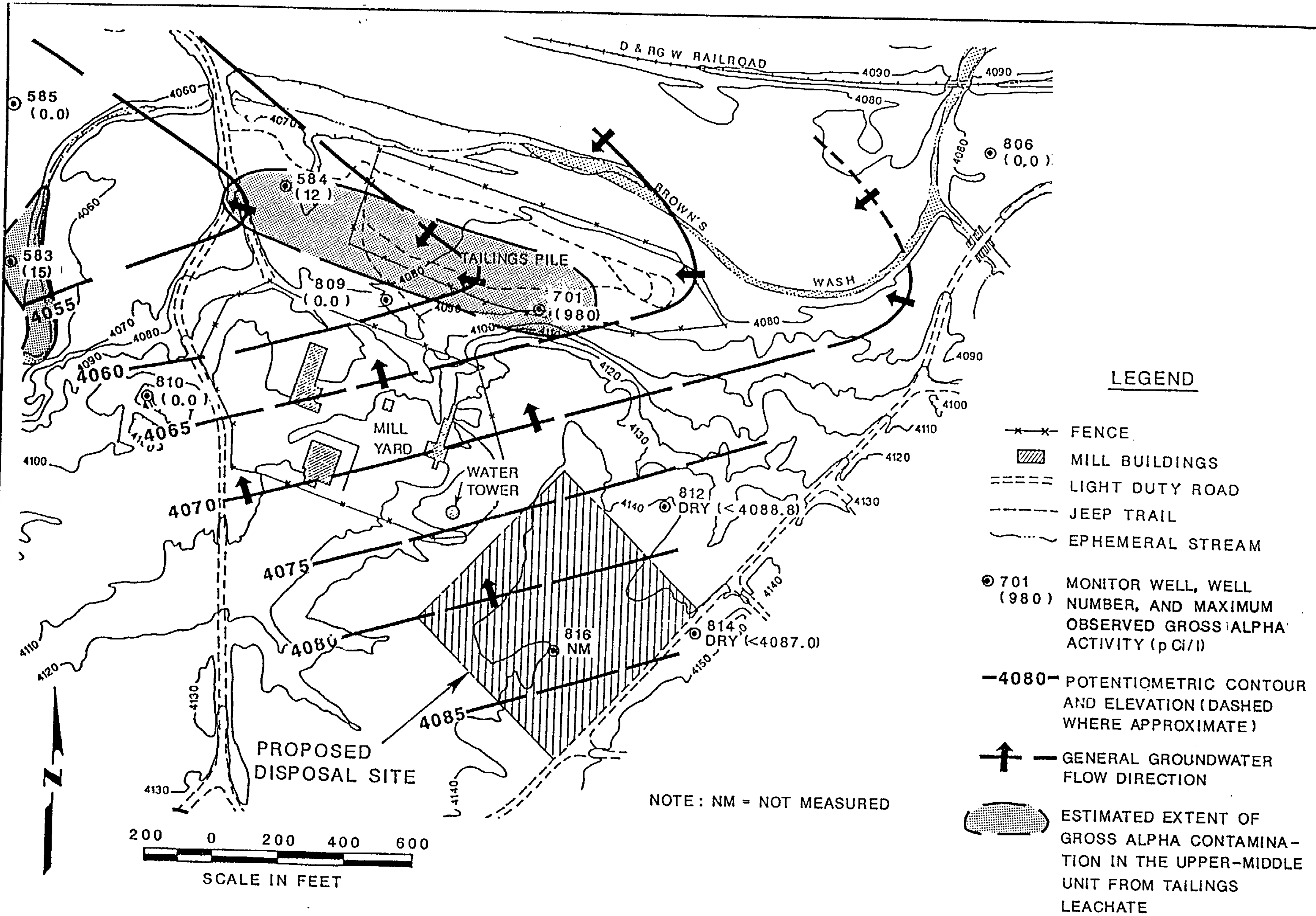


FIGURE D.5.18
MAXIMUM OBSERVED ACTIVITIES AND ESTIM ED EXTENT OF GROSS ALPHA CONTAMINA N THE UPPER-MIDDLE HYDROSTRATIGRAP UNIT, GREEN RIVER, UTAH, TAILINGS SITE

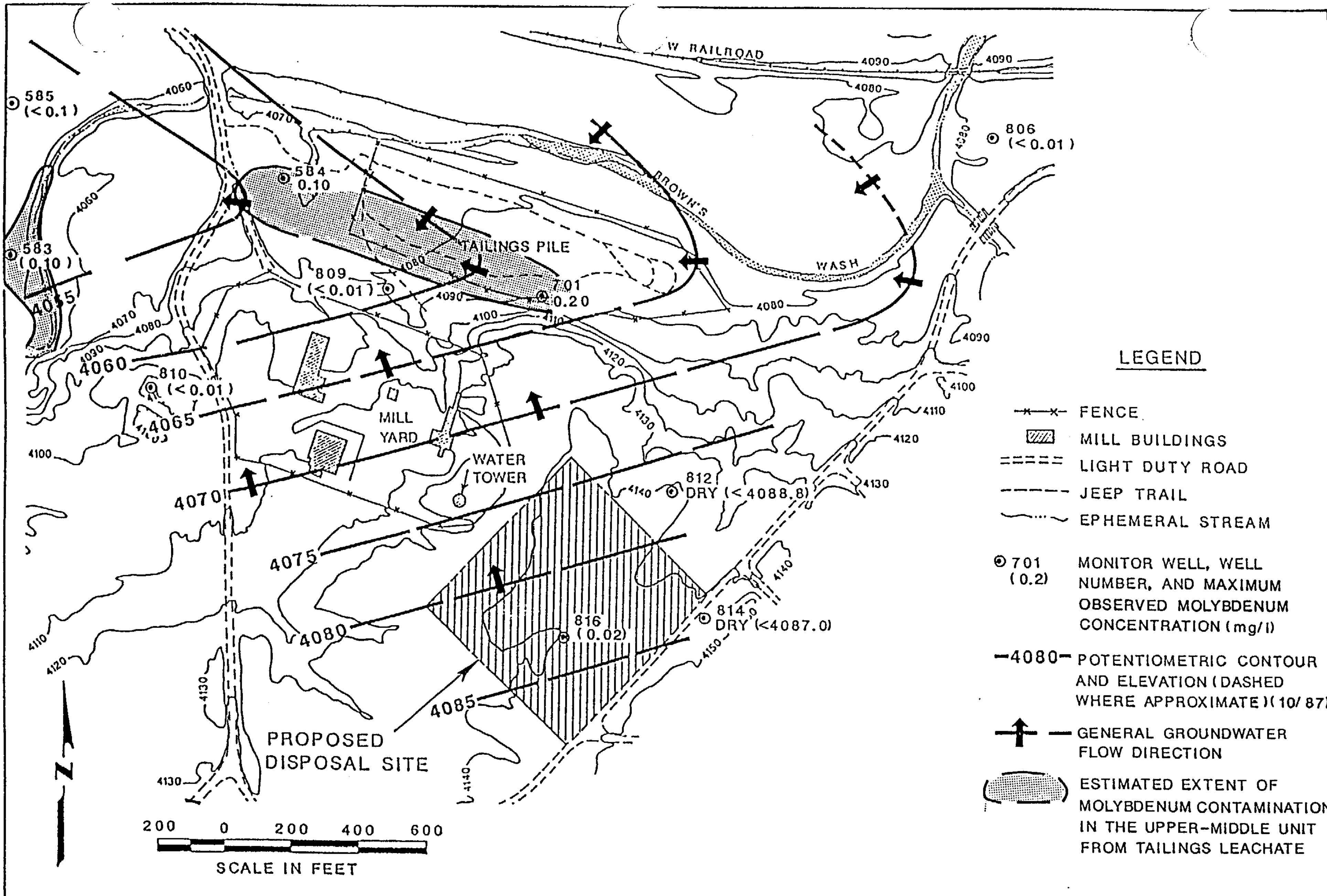


FIGURE D.5.19
MAXIMUM OBSERVED CONCENTRATION AND ESTIMATED EXTENT OF MOLYBDENUM CONTAMINATION IN THE UPPER-MIDDLE HYDROSTRATIGRAPHIC UNIT, GREEN RIVER, UTAH, TAILINGS SITE

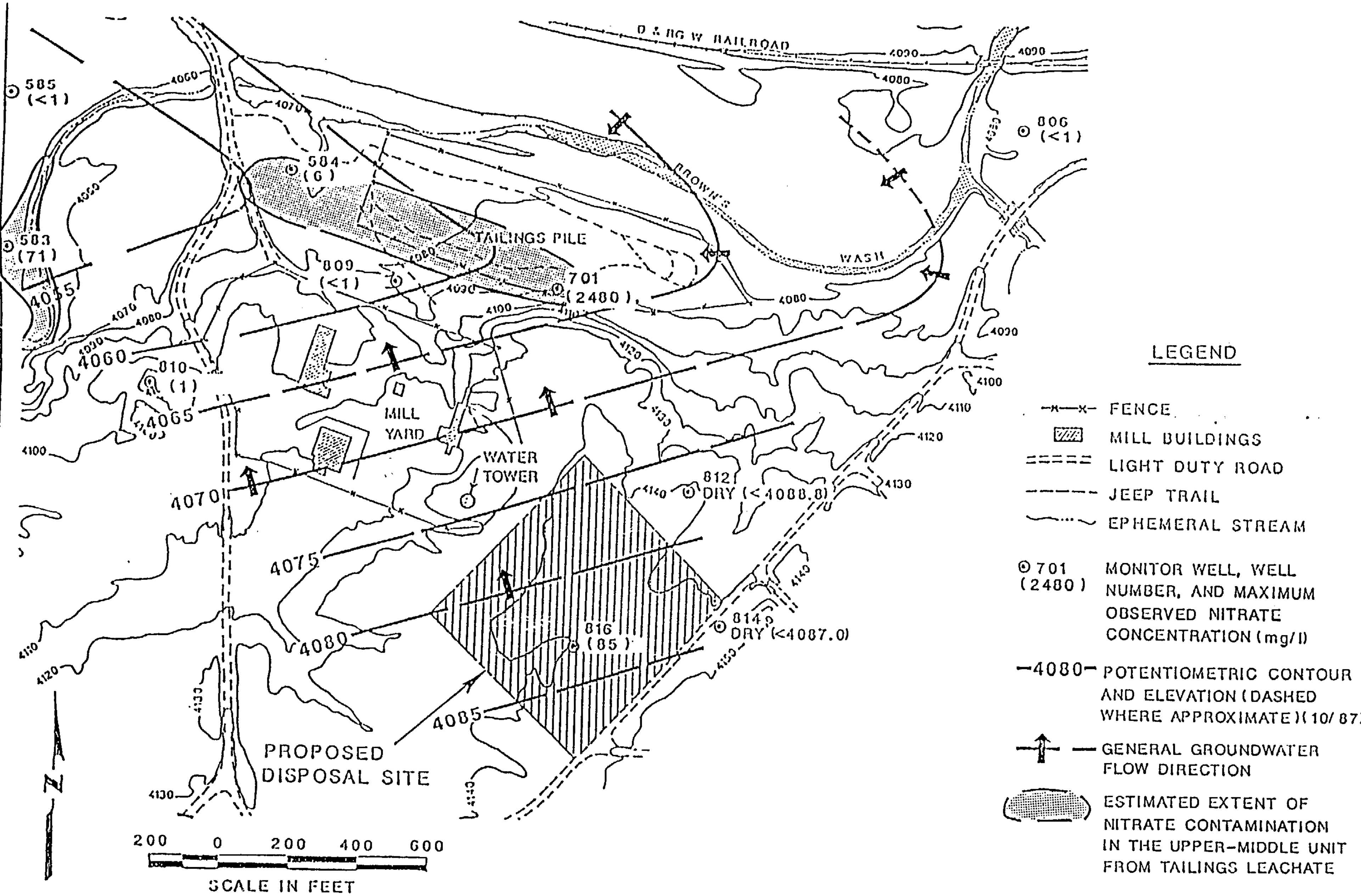


FIGURE D.5.20
MAXIMUM OBSERVED CONCENTRATION AND ESTIMATED EXTENT OF NITRATE CONTAMINATION IN THE UPPER-MIDDLE HYDROSTRATIGRAPHIC UNIT, GREEN RIVER, UTAH, TAILINGS SITE

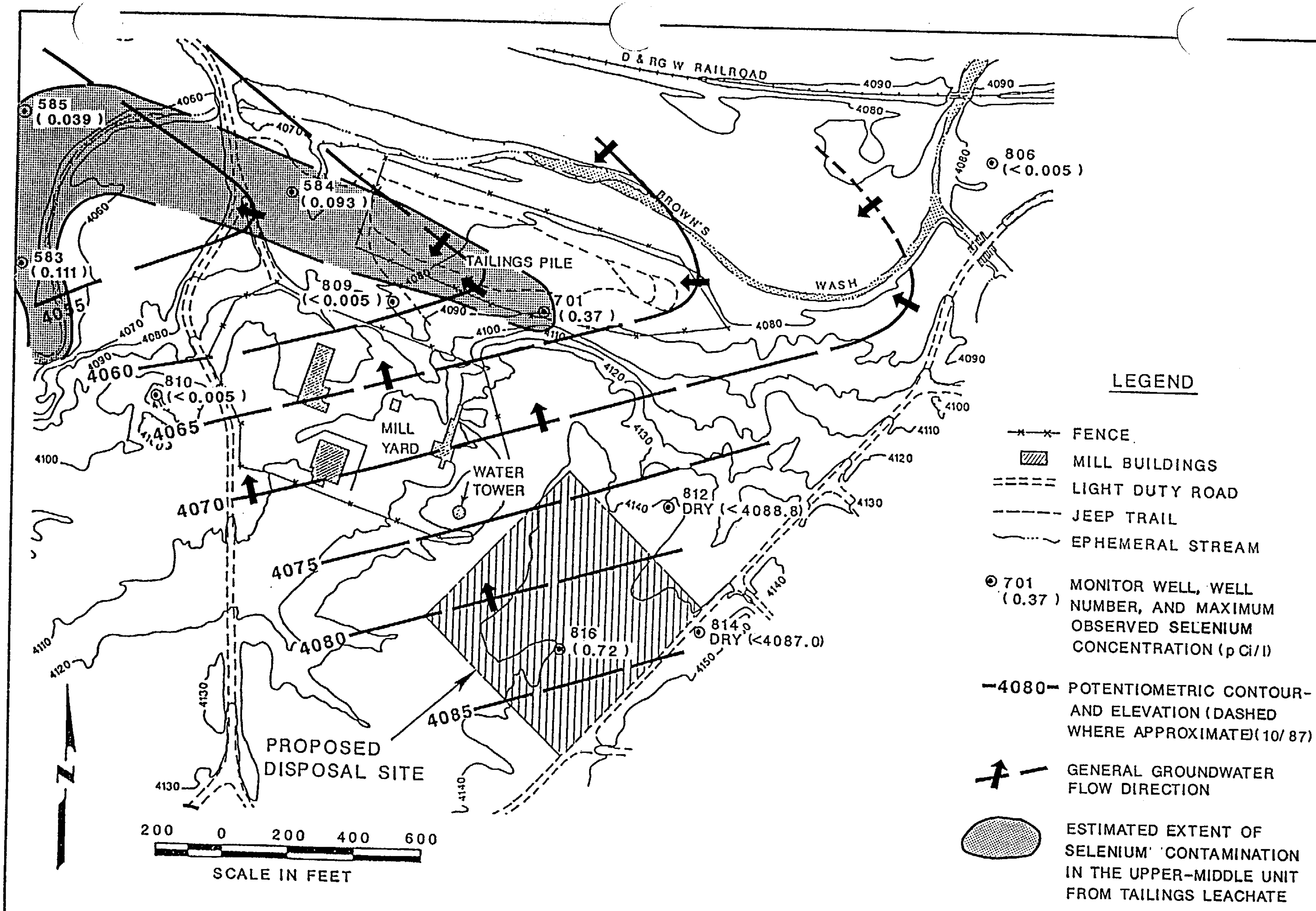


FIGURE D.5.21
MAXIMUM OBSERVED CONCENTRATION AND ESTIMATED EXTENT OF SELENIUM CONTAMINATION IN THE UPPER-MIDDLE HYDROSTRATIGRAPHIC UNIT, GREEN RIVER, UTAH, TAILINGS SITE

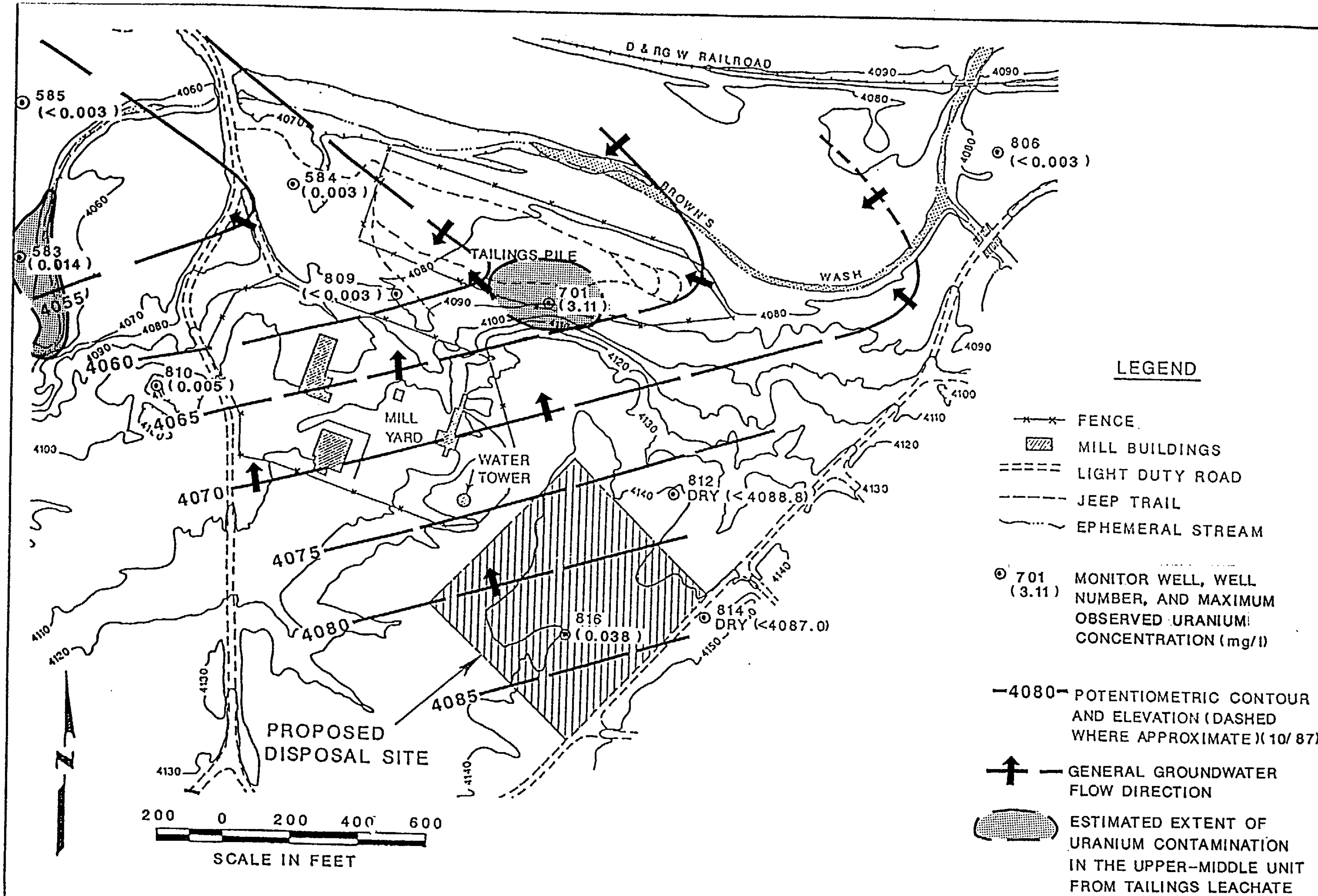
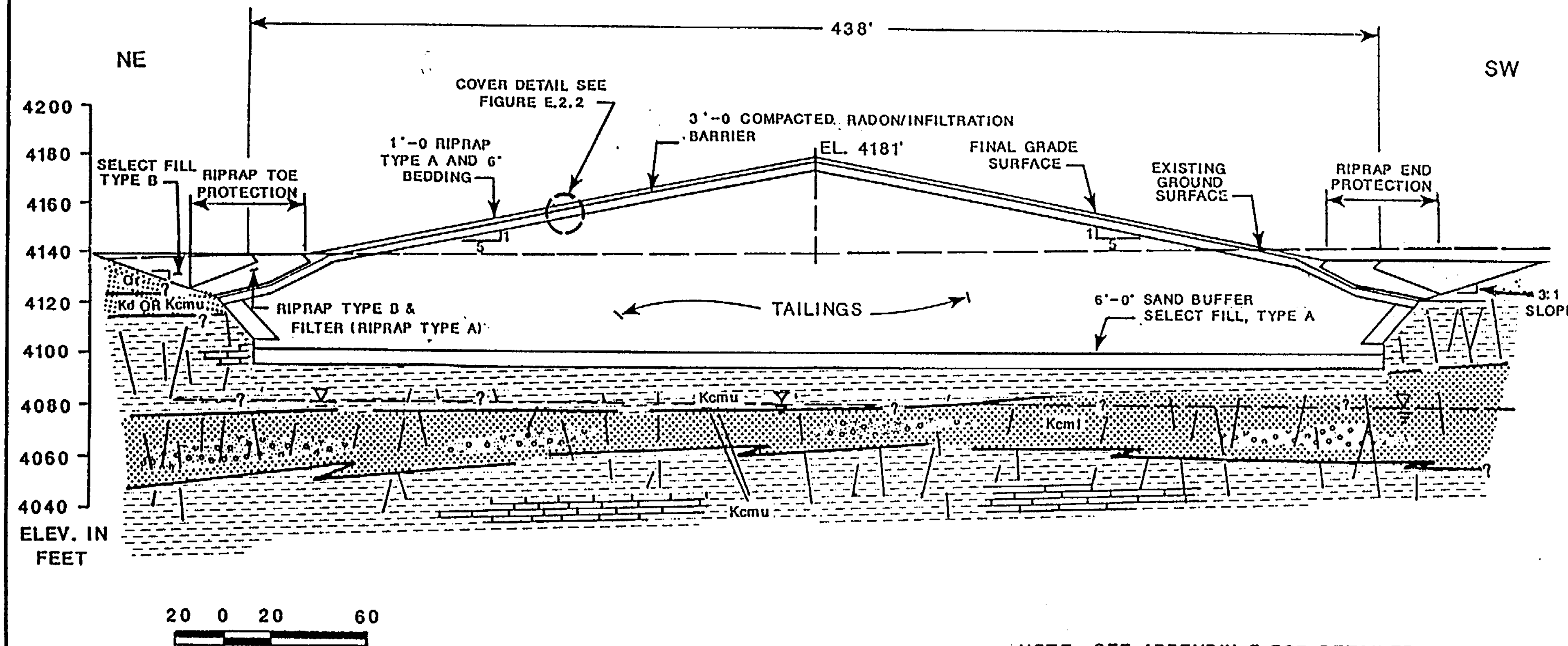


FIGURE D.5.22
MAXIMUM OBSERVED CONCENTRATION AND ESTIMATED EXTENT OF URANIUM CONTAMINAT THE UPPER-MIDDLE HYDROSTRATIGRAI UNIT, GREEN RIVER, UTAH, TAILINGS SIT



NOTE: SEE APPENDIX F FOR DETAILED PLANS AND SPECIFICATIONS

LEGEND

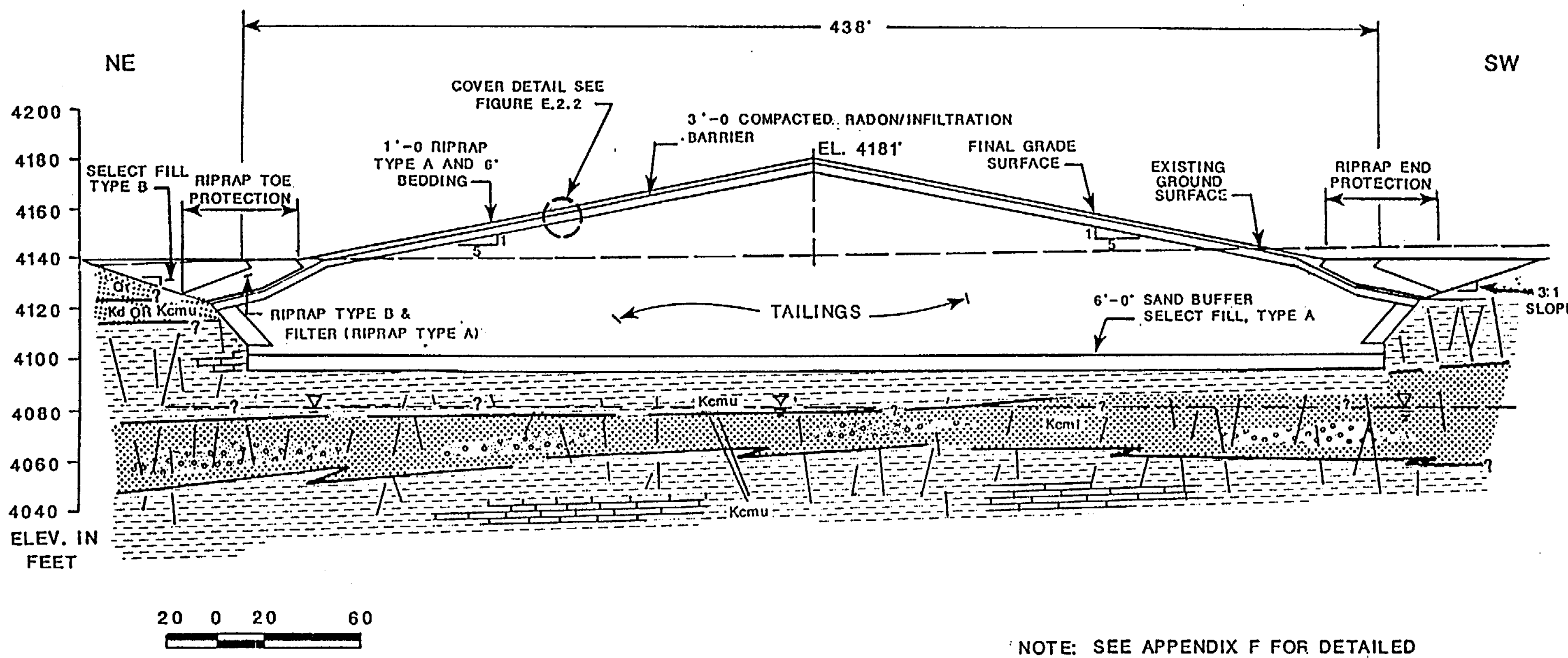
FORMATION		MATERIAL	SYMBOL
Qt	TERRACE SEDIMENTS	SOILS	
Kd	DAKOTA SANDSTONE	BEDROCK	SANDSTONE OR SILTSTONE
Kcmu	CEDAR MOUNTAIN FORMATION UPPER-MIDDLE UNIT		SHALE OR MUDSTONE
			LIMESTONE
Kcml	CEDAR MOUNTAIN FORMATION LOWER-MIDDLE UNIT		CONGLOMERATE

FRACTURES

POTENTIOMETRIC SURFACE

FIGURE D.5.23

DIAGRAMMATIC CROSS SECTION OF PROPOSED DISPOSAL CELL AND FOUNDATION GREEN RIVER, UTAH, TAILINGS SITE



NOTE: SEE APPENDIX F FOR DETAILED PLANS AND SPECIFICATIONS

LEGEND

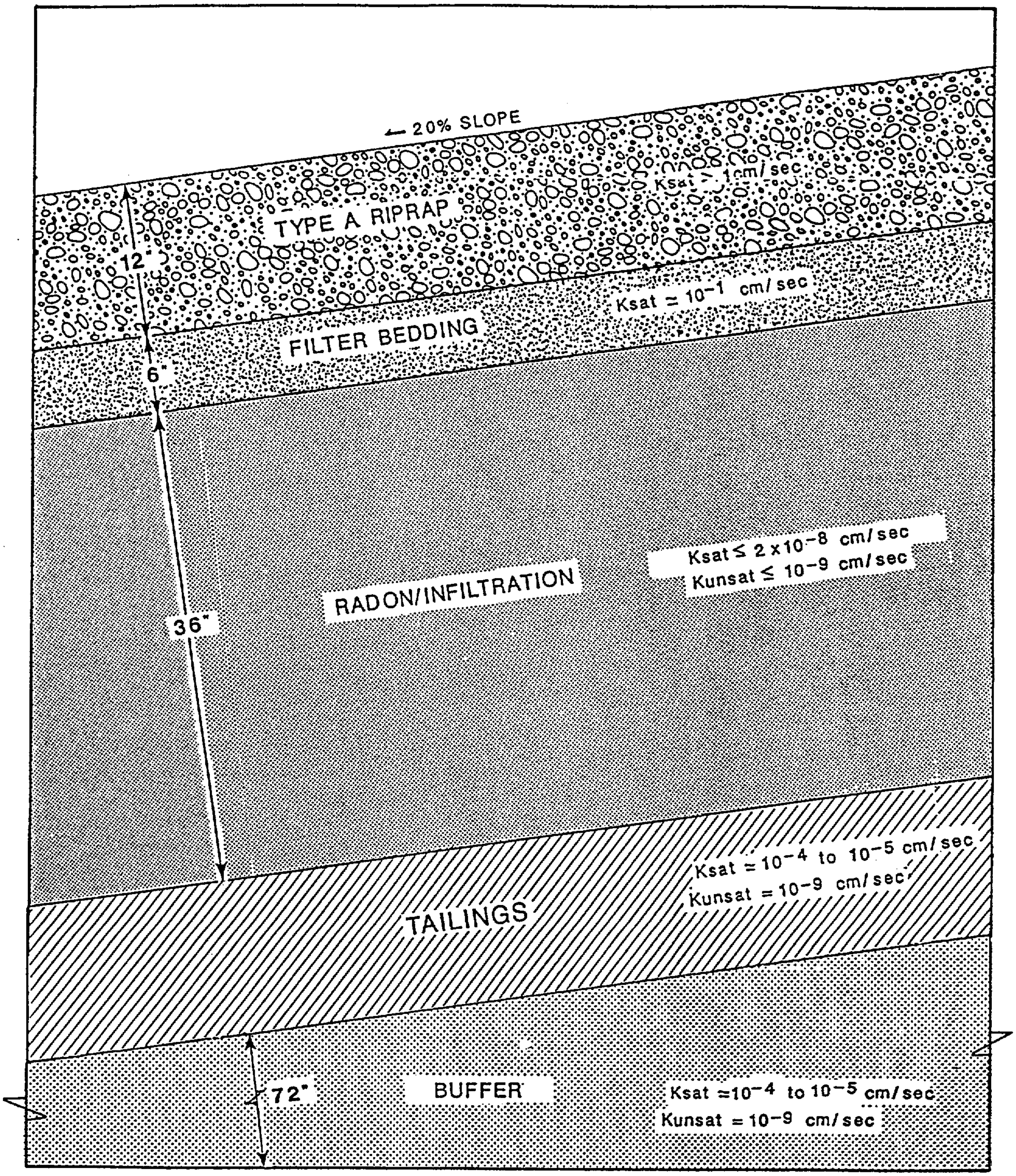
	FORMATION	MATERIAL	SYMBOL
Qt	TERRACE SEDIMENTS	SOILS	
Kd	DAKOTA SANDSTONE	BEDROCK	SANDSTONE OR SILTSTONE
Kcmu	CEDAR MOUNTAIN FORMATION UPPER-MIDDLE UNIT		SWALE OR MUDSTONE
Kcml	CEDAR MOUNTAIN FORMATION LOWER-MIDDLE UNIT		LIMESTONE
			CONGLOMERATE

FRACTURES

POTENTIOMETRIC SURFACE

FIGURE D.5.23

DIAGRAMMATIC CROSS SECTION OF PR[illegible]SED DISPOSAL CELL AND FOUNDATION GREEN RIVER, [illegible]AH, TAILINGS SITE



NOTE: SEE SECTION E.2.2 FOR DETAILED DESCRIPTION OF COVER COMPONENT PROPERTIES; Ksat-SATURATED HYDRAULIC CONDUCTIVITY; Kunsat - UNSATURATED HYDRAULIC CONDUCTIVITY; cm/sec-CENTIMETER PER SEC; SEE FIGURE E.2.1 FOR LOCATION OF THIS DETAIL IN RELATION TO THE DISPOSAL CELL.

FIGURE D.5.24
DISPOSAL CELL COVER SYSTEM
GREEN RIVER, UTAH, TAILINGS SITE

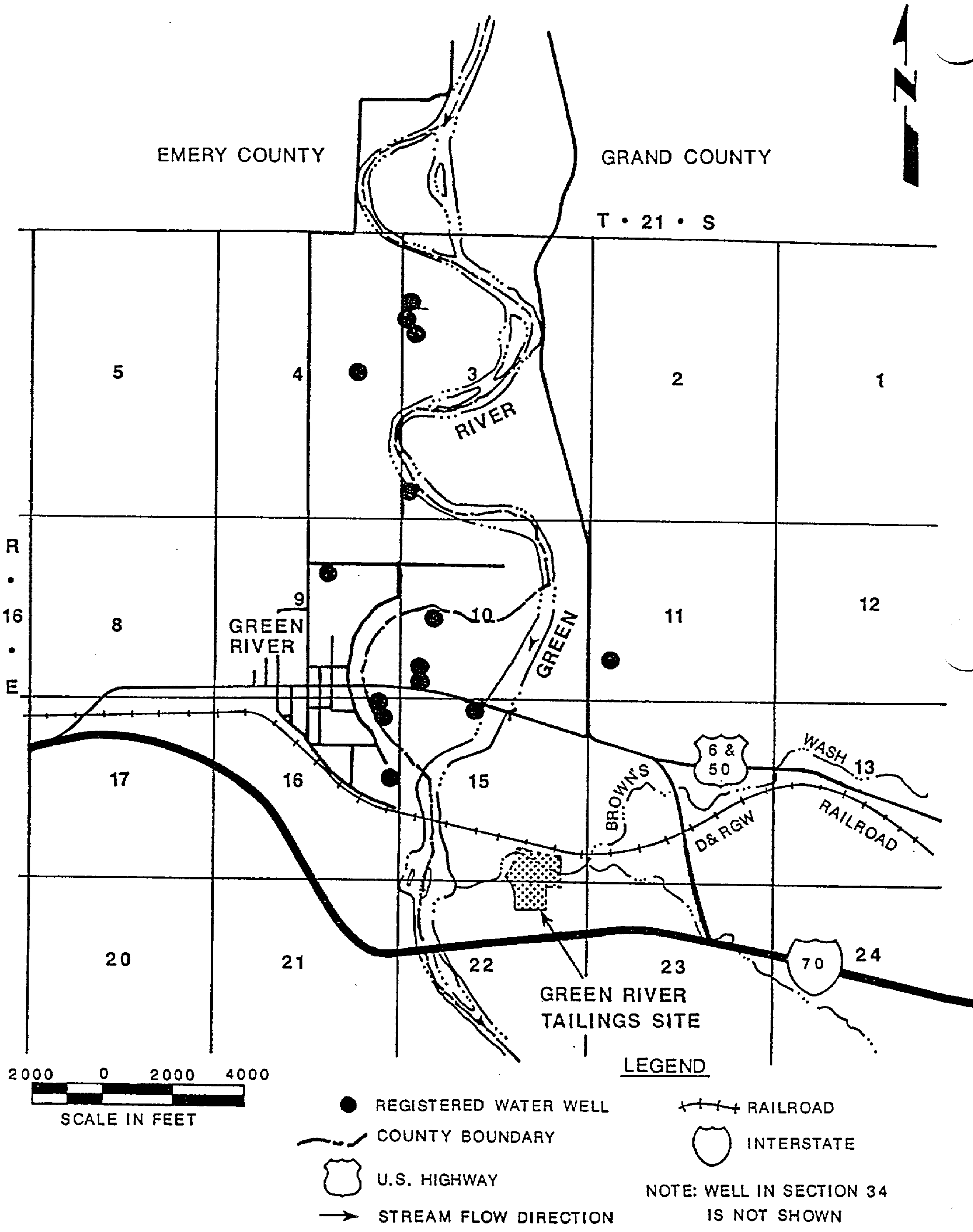


FIGURE D.5.25 LOCATIONS OF REGISTERED WATER WELLS IN TOWNSHIP 21 SOUTH, RANGE 16 EAST, NEAR GREEN RIVER, UTAH

Table D.5.1 Water quality standards and maximum concentration limits applicable to the Green River UMTRA Project site[a]

Constituent	Proposed EPA groundwater maximum concentration limits[b]	EPA National Drinking Water Standards[c] Primary	EPA National Drinking Water Standards[c] Secondary	State of Utah Drinking Water Standards
Inorganic Chemical				
Arsenic	0.05	0.05		0.05
Barium	1.0	1.0		1.0
Boron				0.75
Cadmium	0.010	0.010		0.010
Chloride			250	250
Chromium	0.05	0.05		0.05
Copper			1.0	1.0
Iron			0.3	0.3
Lead	0.05	0.05		0.05
Manganese			0.05	0.05
Mercury	0.002	0.002		0.002
Molybdenum	0.1			
Nitrate	44	44		44
Selenium	0.01	0.01		0.01
Silver	0.05	0.05		0.05
Sulfate			250	250
Zinc			5.0	5.0
TDS			500	500
pH (standard units)			6.5-8.5	6.5-8.5
Radionuclides				
Ra-226 and 228	5.0 pCi/l			5.0 pCi/l
U-234 and 238	30 pCi/l (0.044 mg/l)			
Gross alpha	15 pCi/l			15 pCi/l

[a]Concentrations are given in mg/l except as noted.
[b]Proposed EPA groundwater standards and constituents most commonly associated with uranium mill tailings for UMTRA Project sites; 40 CFR 192. Proposed standards also include a list of hazardous organic constituents, plus antimony, beryllium, and thallium, that are not normally associated with uranium mill tailings or are present in very small quantities; these additional constituents do not have associated maximum concentration limits. See Appendix VIII of 40 CFR 261.
[c]EPA National Drinking Water Standards: Primary, 40 CFR 141; Secondary, 40 CFR 143.

Table D.5.2 Monitor well data, Green River, Utah, tailings site

Location ID	North coordinate (ft)	East coordinate (ft)	Borehole Elevation (ft)	Borehole Depth[a] (ft)	Borehole Diameter (in)	Well casing Elevation (ft)	Well casing Depth[a] (ft)	Well casing Diameter (in)	Screened depth[a] (ft)	Interval length (ft)	Flow relationship
Formation of completion: Alluvium (top unit)											
563	60760.1	60003.5	4079.70	16.0	2.0	4081.10	16.0	2.0	10.0	5.0	Upgradient
564	60917.7	58100.1	4064.60	11.0	2.0	4068.10	11.0	2.0	5.0	5.0	Downgradient
702	60355.8	59295.1	4081.80	43.0	8.0	4082.60	26.0	4.0	15.0	8.0	On-site
704	60556.4	58941.0	4080.70	23.0	8.0	4082.10	23.0	4.0	15.0	8.0	On-site
705	60640.1	58665.7	4076.10	20.0	8.0	4078.30	20.0	4.0	14.0	6.0	On-site
706	60779.0	58379.2	4069.80	34.0	8.0	4070.90	18.0	4.0	8.0	6.0	Downgradient
707	60750.9	60224.0	4081.80	37.0	8.0	4083.10	16.0	4.0	9.0	6.0	Upgradient
708	60605.4	59218.6	4073.10	11.0	8.0	4074.70	11.0	4.0	7.0	4.0	Crossgradient
808	60317.9	59333.8	4082.27	25.0	8.0	4084.27	25.0	4.0	13.0	10.0	On-site
821	60689.9	57916.6	4065.32	7.0	2.0	4068.32	7.0	2.0	2.0	5.0	Downgradient
Formation of completion:[b] Shale (upper-middle unit, Cedar Mountain Formation)											
583	60462.5	57425.9	4065.60	56.5	6.0	4067.10	56.5	2.0	34.5	20.0	Downgradient
584	60654.2	58236.8	4072.10	50.0	6.0	4073.60	50.0	2.0	29.5	20.0	Downgradient
585	60925.6	57423.5	4067.60	50.0	6.0	4069.10	50.0	2.0	39.5	10.0	Downgradient
701	60330.9	58929.2	4087.00	57.0	8.0	4087.20	57.0	4.0	30.0	27.0	On-site
806	60839.6	60243.9	4082.00	67.0	8.0	4084.00	67.0	4.0	55.0	10.0	Upgradient
807	59155.2	58668.8	4139.14	100.0	8.0	4141.14	100.0	4.0	78.0	20.0	Upgradient
809	60371.1	58519.2	4080.30	70.0	8.0	4082.50	70.0	4.0	48.0	20.0	Downgradient
810	60011.6	57868.6	4098.76	80.0	8.0	4100.76	80.0	4.0	58.0	20.0	Downgradient
812	59740.3	59350.1	4142.75	59.0	8.0	4144.75	59.0	4.0	46.0	10.0	Upgradient
814	59377.7	59412.5	4143.03	60.0	8.0	4145.03	60.0	4.0	48.0	10.0	Upgradient
816	59392.3	59003.8	4141.26	60.0	8.0	4143.56	60.0	4.0	48.0	10.0	Upgradient
822	59366.8	59003.0	4140.64	35.0	8.0	4143.14	35.0	4.0	13.0	20.0	Upgradient
823	59408.0	58450.5	4132.86	30.0	8.0	4135.06	30.0	4.0	17.0	10.0	Upgradient
Formation of completion: Sandstone and conglomerate (lower-middle unit, Cedar Mountain Formation)											
561[c]	59838.7	58028.8	4108.70	143.5	6.0	4111.20	143.5	2.0	111.0	30.0	Crossgradient
562[c]	59585.9	59014.3	4143.60	130.0	6.0	4147.70	129.5	2.0	87.5	40.0	Upgradient
581	60450.2	58932.9	4083.30	85.0	8.0	4084.60	85.0	4.0	64.3	20.0	On-site
811	60818.9	60300.0	4082.83	80.0	8.0	4085.33	80.0	4.0	62.5	15.0	Upgradient
813	59622.2	58669.9	4135.10	99.5	8.0	4136.40	99.5	4.0	77.7	20.0	Upgradient
815	60738.7	58225.6	4071.53	100.0	8.0	4073.53	100.0	4.0	88.0	10.0	Downgradient
Formation of completion: Sandstone (bottom unit, Buckhorn Conglomerate Member of Cedar Mountain Formation)											
582	60427.0	57424.8	4065.50	168.5	8.0	4067.00	168.5	4.0	148.0	22.0	Downgradient
586	59171.8	58915.7	4142.40	166.5	8.0	4143.40	166.5	4.0	145.5	20.0	Upgradient
587	59177.2	59540.5	4167.90	185.0	8.0	4169.40	185.0	4.0	164.5	20.0	Upgradient
588	59445.0	57782.7	4112.20	145.0	8.0	4113.50	145.0	4.0	124.3	20.0	Upgradient
817	60794.8	60347.9	4083.31	145.0	8.0	4085.31	145.0	4.0	113.2	30.0	Upgradient
818	59145.1	59189.7	4150.58	187.0	8.0	4152.58	187.0	4.0	165.0	20.0	Upgradient
819	60583.3	58230.8	4072.70	166.0	8.0	4074.70	166.0	4.0	144.0	20.0	Downgradient

[a]Depth below land surface.
[b]Excl[illegible] monitor well 703. The bentonite seal breached in this w[illegible]hortly after installation (DOE, 1983) and information from th[illegible]ll has been [illegible]ded from analyses.
[c]Wells [illegible] and 562 are screened in both the upper-middle and lower-middle hydrostratigraphic units.

Table D.5.3 Summary of aquifer hydraulic characteristics, Green River, Utah, tailings site

Monitor well number[a]	Hydrostratigraphic unit[a]	Tested interval (ft)[b]	Test method[c]	Average hydraulic conductivity (ft/day)[d]	Average transmissivity (ft^2/day)[e]	Average linear velocity (ft/day)[f]
702	Top	15-23.8	PD[g],BR[g]	32.8	289	0.92
704	Top	15-21.2	BR[g],FK,CBP	54.6	339	1.51
705	Top	14-18.6	BR[g]	16.4	75	0.55
706[h]	Top	8-12.5	BR[g]	3.3	15	NA
707	Top	9-12.6	BR[g],FK,CBP	226.3	815	2.19
808	Top	15.8-23.0	BR	11.1	79.9	0.92
583	Upper-Middle	33-53	FK,CBP	2.4	48	0.13
584	Upper-Middle	28-48	FK,CBP	2.4	48	0.12
585	Upper-Middle	28-41	FK,CBP	0.5	10	0.03
701	Upper-Middle	52-57	FK,CBP,BR[g]	17.0	85	0.71
806	Upper-Middle	55-65	FK,CBP	0.23	4.6	0.01
807	Upper-Middle	78-98	FK,CBP	0.0068	0.14	ND
561	Lower-Middle	115-145	FK,CBP	0.0055	0.17	ND
581	Lower-Middle	63-83	FK,PR	21.6	432	2.7
811	Lower-Middle	62.5-77.5	FK,CBP	0.22	3.28	0.02
813	Lower-Middle	77.7-97.7	FK,CBP,PD	4.53	90.8	0.19
815	Lower-Middle	88-98	FK,CBP	0.37	3.7	0.04
582	Bottom	146.5-166.5	FK,CBP,PR	3.6	72	0.072
586	Bottom	144.5-164.5	FK,CBP,PR	0.13	2.6	ND
587	Bottom	163-183	FK,CBP,PR	0.076	1.5	ND
588	Bottom	123-143	FK,CBP,PR	5.8	116	0.13
818	Bottom	165-185	FK,CBP	7.6	151	0.17

[a]See Figure D.5.1 for locations of monitor wells. Slug tests were unsuccessful for well 708 and no data are available. Well 561 is partially screened in the upper-middle unit. Wells 562 and 703 were not tested. Wells 586 and 587 were grout-contaminated at the time of testing, and hydraulic conductivity values are not representative of bottom unit. Well 807 is screened in the upper-middle unit below the lower-middle unit.

[b]Tested interval is in feet below land surface.

[c]PD is pumping drawdown (type-curve) method; PR is pumping recovery (single well) method; BR is Bouwer and Rice slug test method; FK is Ferris and Knowles slug test method; CBP is Cooper, Bredehoeft, and Papadopulos slug test method.

[d]Arithmetic average of all applied methods of analysis; wells 701, 704, and 707 have been tested twice.

[e]Average hydraulic conductivity multiplied by tested interval length.

[f]Average linear velocity calculated for silty, gravelly sand (top unit, assumed porosity of 0.30); shale and limestone (upper-middle unit, assumed porosity of 0.15); sandstone and sandstone conglomerate (lower middle unit, assumed porosity of 0.20); sandstone/conglomerate (bottom unit, assumed porosity of 0.20) (Walton, 1970). NA = not available; ND = not determined.

[g]Analyses by DOE (1983).

[h]Hydraulic conductivity at well 706 was measured shortly after drilling by DOE (1983), but the well has been dry for each sampling period thereafter.

Table D.5.4 Triaxial hydraulic conductivities of selected rock core from monitor wells 907, 813, 816, and 818, Green River, Utah, tailings site

Location ID[a]	Sample ID	Depth interval (ft)[b]	Test meth.[c]	Moisture content (%)		Dry density (PCF)[d]		Saturation (%)		Total pressure head (ft)	Hydraulic conductivity (cm/s)
				Init.	Final	Init.	Final	Init.	Final		
807	A	50 (Kcml)	TX	1.1	3.5	159.3	159.3	31.8	100	97.0	4.7×10^{-10}
807	B	80 (Kcmu)	TX	2.4	5.0	153.4	153.4	47.7	100	95.6	2.4×10^{-11}
813	A	40 (Kcmu)	TX	7.6	14.9	137.8	120.7	89.7	100	95.7	1.3×10^{-9}
813	B	65 (Kcml)	TX	0.8	4.8	149.2	149.2	17.0	100	4.3	7.0×10^{-9}
816	A	40 (Kcmu)	TX	8.5	12.6	133.9	125.0	92.6	100	96.4	3.5×10^{-9}
816	B	65 (Kcml)	TX	1.6	7.0	141.8	141.8	22.8	100	4.4	2.4×10^{-8}
818	A	125 (Kcm)	TX	8.0	14.6	139.2	123.4	90.5	100	95.0	5.0×10^{-9}

Location/sample ID	Depth, ft	Unit and visual description
807-A	50	Kcm lower-middle unit: Siltstone, light buff to gray, moderately well cemented, minor horizontal fracturing with iron staining.
807-B	80	Kcm upper-middle unit below the lower-middle sand: Shale, medium gray, moderately well cemented, minor cemented horizontal fractures, layering, minor pyrite crystallization.
813-A	40	Kcm upper-middle unit: Shale, dark gray, fissle, moderately well cemented, secondary mineral- tion in horizontal joints as calcite or gy iron staining.
813-B	65	Kcm lower-middle unit: Sandstone, silty, very fine grained, soft, gray and light brown, minor iron staining.
816-A	40	Kcm upper-middle unit: Shale and mudstone, light gray micro-crystalline to dark gray fissle; secondary mineralization and iron staining on layered surfaces.
816-B	65	Kcm lower-middle unit: Sandstone, medium brown to gray speckled, silty, fine to very fine grained, minor mud inclusions.
818-A	125-130	Kcm confining unit for bottom unit: Shale, fissle, moderately hard to soft, dark purple and medium gray.

[a]See Figure D.5.1 for location of monitor wells.
[b]Kcml = lower-middle unit Cedar Mountain Formation; Kcmu = upper-middle unit of Cedar Mountain Formation; Kcm = Cedar Mountain Formation between lower-middle and bottom unit.
[c]TX = Triaxial back pressure falling head method.
[d]PCF = pounds per cubic foot (lb/ft^3).

Table D.5.5 Groundwater elevations, Green River, Utah, tailings site

Well number	Elevation (top of casing)	Water elevation[a]			
		June 1986	September 1986	March 1987	October 1987
Top unit					
563	4081.1	4069.2	4070.1	4069.2	4069.6
564	4068.1	Dry	Dry	Dry	Destroyed
702	4082.6	4067.3	4068.3	4067.9	4067.1
704	4082.1	4065.2	4065.4	4065.4	Clogged
705	4078.3	4062.9	4063.3	4063.6	4062.7
706	4070.9	Dry	Dry	Dry	Dry
707	4083.1	4070.2	4070.9	4070.8	4069.7
708	4074.7	NS	4065.4	4066.7	Clogged
808	4084.3	NS	NS	NS	4068.1
821	4068.3	NS	NS	NS	Dry
Upper-middle unit					
583	4067.1	NS	4052.4	4051.0	4049.6
584	4073.6	NS	4058.8	4059.5	4058.2
585	4069.1	NS	4054.7	4055.2	4054.7
701	4087.9	4062.8	4062.7	4063.1	4061.3
806	4084.0	NS	NS	NS	4071.9
807[b]	4141.1	NS	NS	NS	4088.4
809	4082.5	NS	NS	NS	4058.6
810	4100.8	NS	NS	NS	4063.0
812	4144.8	NS	NS	NS	Dry
814	4145.0	NS	NS	NS	Dry
816	4143.6	NS	NS	NS	4083.8
822	4143.1	NS	NS	NS	Dry
823	4135.1	NS	NS	NS	Dry
Lower-middle unit					
561[b]	4111.2	4085.8	4084.3	4082.6	4081.0
562[b]	4147.7	4087.5	4088.3	4088.4	4086.7
581	4084.6	NS	Flowing(NM)	Flowing(NM)	4087.2
811	4085.3	NS	NS	NS	4072.3
813	4136.4	NS	NS	NS	4084.6
815	4073.5	NS	NS	NS	4068.5

Table D.5.5 Groundwater elevations, Green River, Utah, tailings site (Concluded)

Well number	Elevation (top of casing)	Water elevation[a]			
		June 1986	September 1986	March 1987	October 1987
Bottom unit					
582	4067.0	NS	Flowing(NM)	Flowing(NM)	4080.8
586	4143.4	NS	4085.6	4087.6	4086.9
587	4169.4	NS	4086.3	4094.8	4097.9
588	4113.5	NS	4083.1	4086.2	4085.4
817[b]	4085.3	NS	NS	NS	4085.7
818	4152.6	NS	NS	NS	4086.4
819	4074.7	NS	NS	NS	4080.1

[a]NS = well was either not sampled or was not yet installed; NM = not measured; Destroyed = surface casing was destroyed and well could not be measured; Clogged = well sounder could not be lowered down the casing because of an obstruction in the well. The potentiometric surface in the flowing wells was measured by shutting the well in and measuring the shut in pressure and/or by using a clear plastic riser hose, if possible.

[b]Monitor wells 561 and 562 partially screen the upper-middle and lower-middle units; monitor well 807 screens the upper-middle unit below the lower-middle unit; monitor well 817 probably does not screen the bottom unit (see text for explanation).

Table D.5.6 Summary of aquifer hydraulic characteristics for the top hydrostratigraphic unit, Green River, Utah, tailings site[a]

Monitor well number	Average hydraulic conductivity (ft/day)	Average transmissivity (ft^2/day)	Average linear velocity (ft/day)
702	32.8	289	0.92[b]
704	54.6	339	1.51
705	16.4	75	0.55
706[c]	3.3	15	NA
707	226.3	815	2.19
808	11.1	80	0.92[b]
mean[d]	25.0	139	1.14

[a]Linear velocity is a function of an assumed porosity of 0.30 for silty, gravelly sand (Walton, 1970); NA = not available (see Footnote c); hydraulic gradient is calculated at each well from October 1987 water levels.
[b]Average of monitor wells 702 and 808.
[c]Hydraulic conductivity at monitor well 706 was measured shortly after drilling by DOE (1983), but the well has been dry for each sampling period thereafter.
[d]Geometric mean.

Table D.5.7 Groundwater flux within the top hydrostratigraphic unit beneath the present tailings, Green River, Utah, tailings site

Flux component	Monitor wells 702 and 808	Monitor well 704	Monitor well 705
v (ft/day)[a]	0.28	0.45	0.17
W (ft)[b]	300	275	425
D (ft)[c]	9.7	6.3	4.4
Q (ft^3/s)[d]	0.0094	0.0090	0.0036
Q (gpm)[d]	4.2	4.1	1.6
Total flux = 4.2 + 4.1 + 1.6 = 9.9 gpm			

[a]Groundwater velocity.
[b]Width perpendicular to groundwater flow beneath the tailings pile represented by the respective well(s).
[c]Depth of flow represented by the depth of water in the respective well(s).
[d]Groundwater flux for incremental area represented by the respective well(s).

Table D.5.8 Summary of aquifer hydraulic characteristics for the upper-middle hydrostratigraphic unit, Green River, Utah, tailings site[a]

Monitor well number	Average hydraulic conductivity (ft/day)	Average transmissivity (ft^2/day)	Average linear velocity (ft/day)
583	2.4	48	0.13
584	2.4	48	0.12
585	0.5	10	0.03
701	17.0	85	0.71
806	0.2	5	0.01
mean[b]	1.6	25	0.08

[a]Linear velocity is a function of an assumed porosity of 0.15 for shale and limestone (Walton, 1970); hydraulic gradient is calculated at each well from October 1987 water levels.
[b]Geometric mean.

Table D.5.9 Groundwater flux within the upper-middle hydrostratigraphic unit beneath the present tailings, Green River, Utah, tailings site

Flux component	Monitor well 584	Monitor well 701	Average of monitor wells 584 and 701
v (ft/day)[a]	0.018	0.107	0.063
W (ft)[b]	450	450	450
D (ft)[c]	34.6	31.1	32.9
Q (ft^3/s)[d]			0.011
Q (gpm)[d]			4.9

[a]Groundwater velocity.
[b]Width perpendicular to groundwater flow beneath the tailings pile.
[c]Depth of flow represented by the depth of water in the respective well(s).
[d]Total groundwater flux.

Table D.5.10 Summary of aquifer hydraulic characteristics for the lower-middle hydrostratigraphic unit, Green River, Utah, tailings site[a]

Monitor well number	Average hydraulic conductivity (ft/day)	Average transmissivity (ft^2/day)	Average linear velocity (ft/day)
581	21.6	432	2.70
811	0.2	3	0.02
813	4.5	91	0.19
815	0.4	4	0.04
mean[b]	1.7	26	0.14

[a]Linear velocity is a function of an assumed porosity of 0.20 for sandstone and conglomerate (Walton, 1970); hydraulic gradient is calculated at each well from October 1987 water levels.
[b]Geometric mean.

Table D.5.11 Summary of aquifer hydraulic characteristics for the bottom hydrostratigraphic unit, Green River, Utah, tailings site[a]

Monitor well number	Average hydraulic conductivity (ft/day)	Average transmissivity (ft^2/day)	Average linear velocity (ft/day)
582	3.6	72	0.07
588	5.8	116	0.13
818	7.6	151	0.17
mean[b]	5.3	103	0.12

[a]Linear velocity is a function of an assumed porosity of 0.20 for sandstone and conglomerate (Walton, 1970); hydraulic gradient is calculated at each well from October 1987 water levels.
[b]Geometric mean.

Table D.5.12 Summary of vertical hydraulic gradients beneath the present tailings pile, Green River, Utah, tailings site[a]

	Top unit	Upper-middle unit	Lower-middle unit	Bottom unit
Top unit	--	0.12 downward	0.38 upward	0.11 upward
Upper-middle unit	--	--	0.87 upward	0.16 upward
Lower-middle unit	--	--	--	0.07 downward

[a]Gradient values are in foot per foot. Gradients were calculated using October 1987 water levels at the areal center of the tailings pile; the vertical distance between units was measured from cross section B-B' on Figure D.5.3.

Table D.5.13 Summary of vertical hydraulic gradients beneath the proposed disposal site, Green River, Utah, tailings site[a]

	Top unit	Upper-middle unit	Lower-middle unit	Bottom unit
Top unit	(The top unit is not present at the disposal site)[b]			
Upper-middle unit	--	--	0.55 upward	0.03 upward
Lower-middle unit	--	--	--	0.02 downward

[a]Gradient values are in foot per foot. Gradients were calculated using October 1987 water levels at the areal center of the disposal site; the vertical distance between units was measured from cross section C-C' in Figure D.5.4.
[b]Groundwater is first encountered at a depth of about 60 feet beneath the proposed disposal site (near the contact of the upper-middle unit with the lower-middle unit).

Table D.5.14 Description of groundwater samples, Green River, Utah, tailings site

Sample number	Hydrostratigraphic unit	Description of sample location
563	Top	Well point, north side of Brown's Wash, approximately 250 feet upgradient from tailings.
702	Top	Well, on-site.
704	Top	Well, on-site.
705	Top	Well, west edge of tailings, on-site.
707	Top	Well, south side of Brown's Wash approximately 900 feet upgradient from tailings.
708	Top	Well, between Brown's Wash and tailings, crossgradient.
808	Top	Well, 60 feet east of well 702, on-site.
583	Upper-middle	Well, north side of Brown's Wash, approximately 1000 feet downgradient from tailings.
584	Upper-middle	Well, south side of Brown's Wash, approximately 200 feet downgradient from tailings.
585	Upper-middle	Well, north side of Brown's Wash, approximately 1100 feet downgradient from tailings.
701	Upper-middle	Well, on-site.
806	Upper-middle	Well, upgradient, approximately 75 feet north of well 707.
809	Upper-middle	Well, downgradient, north of mill yard.
810	Upper-middle	Well, downgradient, in retention structure west of mill yard.
816	Upper-middle	Well, upgradient, center of disposal site.
561	Lower-middle	Well, approximately 100 feet southwest of mill site, west side of road and crossgradient from tailings.

Table D.5.14 Description of groundwater samples, Green River, Utah, tailings site (Concluded)

Sample number	Hydrostratigraphic unit	Description of sample location
562	Lower-middle	Well, approximately 600 feet south (upgradient) from tailings, and 1000 feet east of well 561, located on proposed disposal site.
581	Lower-middle	Flowing well, on-site, between wells 701 and 704.
811	Lower-middle	Well, upgradient, approximately 60 feet east of well 808.
813	Lower-middle	Well, upgradient near disposal site, 100 feet south of water tower.
815	Lower-middle	Well, downgradient, west of tailings.
582	Bottom	Flowing well, north of Brown's Wash, adjacent to well 583 and downgradient from tailings.
586	Bottom	Well, approximately 1100 feet south of and upgradient from tailings, located on SOS disposal site.
587	Bottom	Well, approximately 120 feet southeast of tailings and 650 feet east of well 586, and upgradient from tailings.
588	Bottom	Well, approximately 1200 feet southwest of mill site and 1200 feet west of well site and upgradient from tailings.
818	Bottom	Well, between wells 587 and 586, upgradient from tailings.
819	Bottom	Well, downgradient, west of tailings.

Table D.5.15 Chemical analyses of groundwater, Green River, Utah, tailings site

FORMATION OF COMPLETION: URANIUM MILL TAILINGS
HYDRAULIC FLOW RELATIONSHIP: ON-SITE

		LOCATION ID - SAMPLE ID AND LOG DATE				
		714-01 03/12/87	714-01 09/11/86			
PARAMETER	UNIT OF MEASURE	PARAMETER VALUE+/-UNCERTAINTY	PARAMETER VALUE+/-UNCERTAINTY	PARAMETER VALUE+/-UNCERTAINTY	PARAMETER VALUE+/-UNCERTAINTY	PARAMETER VALUE+/-UNCERTAINTY
ALUMINUM	MG/L	6300.	1840.			
AMMONIUM	MG/L	14.	11.			
ANTIMONY	MG/L	-	< 0.003			
ARSENIC	MG/L	-	0.03			
BARIUM	MG/L	-	< 0.1			
BORON	MG/L	0.5	< 0.1			
CADMIUM	MG/L	-	0.032			
CALCIUM	MG/L	457.	385.			
CHLORIDE	MG/L	113.	2900.			
CHROMIUM	MG/L	2.61	1.14			
COBALT	MG/L	-	30.9			
COPPER	MG/L	-	45.8			
FLUORIDE	MG/L	< 0.1	0.2			
IRON	MG/L	2200.	267.			
LEAD	MG/L	-	0.02			
MAGNESIUM	MG/L	2640.	1090.			
MANGANESE	MG/L	360.	122.			
MERCURY	MG/L	-	0.			
MOLYBDENUM	MG/L	0.2	0.10			
NICKEL	MG/L	-	25.3			
NITRATE	MG/L	4500.	2.			
NITRITE	MG/L	-	< 0.1			
PHOSPHATE	MG/L	-	< 0.1			
POTASSIUM	MG/L	0.19	16.0			
SELENIUM	MG/L	0.092	0.208			
SILICA	MG/L	-	60.			
SILVER	MG/L	-	< 0.01			
SODIUM	MG/L	89.2	111.			
STRONTIUM	MG/L	-	0.1			
SULFATE	MG/L	56200.	16000.			
TIN	MG/L	-	< 0.005			
TOTAL SOLIDS	MG/L	80800.	26100.			
URANIUM	MG/L	675.	221.			
VANADIUM	MG/L	-	178.			
ZINC	MG/L	-	259.			

Table D.5.15 Chemical analyses of groundwater, Green River, Utah, tailings site (Continued)

FORMATION OF COMPLETION: ALLUVIUM
HYDRAULIC FLOW RELATIONSHIP: UP GRADIENT

		LOCATION ID - SAMPLE ID AND LOG DATE						
		563-01 06/04/86	563-01 09/07/86	563-01 02/27/87	563-01 10/02/87		563-01 01/10/88	
PARAMETER	UNIT OF MEASURE	PARAMETER VALUE+/-UNCERTAINTY	PARAMETER VALUE+/-UNCERTAINTY	PARAMETER VALUE+/-UNCERTAINTY	PARAMETER VALUE+/-UNCERTAINTY		PARAMETER VALUE+/-UNCERTAINTY	
ALKALINITY	MG/L CACO3	157.	182.	138.	165.		162.	
ALUMINUM	MG/L	0.4	0.3	< 0.1	< 0.1		0.3	
AMMONIUM	MG/L	< 0.1	< 0.1	< 0.1	0.1		< 0.1	
ANTIMONY	MG/L	< 0.003	< 0.003	-	-		-	
ARSENIC	MG/L	< 0.01	< 0.01	-	0.01		0.01	
BALANCE	%	0.16	0.06	-	-		-	
BARIUM	MG/L	0.2	0.2	-	-		-	
BICARBONATE	MG/L	-	-	-	-		-	
BORON	MG/L	0.3	0.5	0.22	0.4		0.48	
CADMIUM	MG/L	< 0.001	< 0.001	-	-		-	
CALCIUM	MG/L	488.	500.	377.	410.		417.	
CHLORIDE	MG/L	312.	240.	312.	290.		310.	
CHROMIUM	MG/L	0.05	0.02	0.03	< 0.01		0.03	
COBALT	MG/L	0.09	0.07	-	-		-	
CONDUCTANCE	UMHO/CM	5500.	6250.	6500.	8300.		6530.	
COPPER	MG/L	0.05	0.03	-	-		-	
FLUORIDE	MG/L	0.6	0.7	0.48	0.6		0.48	
GROSS ALPHA	PCI/L	-	-	-	0.0	43.	41.	38.
GROSS BETA	PCI/L	-	-	-	15.	48.	1.	27.
IRON	MG/L	0.18	0.20	0.59	0.79		1.23	
LEAD	MG/L	< 0.01	< 0.01	-	-		-	
MAGNESIUM	MG/L	364.	367.	347.	340.		337.	
MANGANESE	MG/L	0.04	0.03	0.03	< 0.01		0.06	
MERCURY	MG/L	< 0.0002	< 0.0002	-	-		-	
MOLYBDENUM	MG/L	0.15	0.14	< 0.1	< 0.01		0.20	
NICKEL	MG/L	0.09	< 0.04	-	-		-	
NITRATE	MG/L	11.	41.	44.3	34.		23.9	
NITRITE	MG/L	< 0.1	< 0.1	-	-		-	
ORG. CARBON	MG/L	-	-	-	< 1.		39.8	
PB-210	PCI/L	-	-	-	-		-	
PH	SU	7.69	7.55	7.58	7.25		7.5	
PHOSPHATE	MG/L	< 0.1	< 0.1	-	-		-	
PO-210	PCI/L	-	-	-	-		-	
POTASSIUM	MG/L	18.8	22.6	12.6	16.7		17.4	
RA-226	PCI/L	-	-	-	0.3	0.2	0.	0.1
RA-228	PCI/L	-	-	-	1.4	1.0	0.4	0.9
SELENIUM	MG/L	< 0.005	< 0.005	0.38	0.12		0.320	
SILCON	MG/L	-	-	-	-		-	
SILICA	MG/L	4.	7.	-	-		-	
SILVER	MG/L	< 0.01	< 0.01	-	-		-	
SODIUM	MG/L	1680.	1830.	1840.	1600.		1900.	
STRONTIUM	MG/L	7.2	0.6	-	-		-	
SULFATE	MG/L	5540.	5960.	5490.	5500.		574[illegible]	
SULFIDE	MG/L	-	-	-	-		-	
TEMPERATU	C - DEGREE	19.	17.	9.5	17.5		9.9	
TH-230	PCI/L	-	-	-	-		-	

Table D.5.15 Chemical analyses of groundwater, Green River, Utah, tailings site (Continued)

FORMATION OF COMPLETION: ALLUVIUM
HYDRAULIC FLOW RELATIONSHIP: UP GRADIENT

		LOCATION ID - SAMPLE ID AND LOG DATE				
		563-01 06/04/86	563-01 09/07/86	563-01 02/27/87	563-01 10/02/87	563-01 01/10/88
PARAMETER	UNIT OF MEASURE	PARAMETER VALUE+/-UNCERTAINTY	PARAMETER VALUE+/-UNCERTAINTY	PARAMETER VALUE+/-UNCERTAINTY	PARAMETER VALUE+/-UNCERTAINTY	PARAMETER VALUE+/-UNCERTAINTY
TIN	MG/L	< 0.005	< 0.005	-	-	-
TOTAL SOLIDS	MG/L	9230.	8800.	9240.	8740.	9080.
URANIUM	MG/L	0.0121	0.0104	0.0105	0.013	0.0105
VANADIUM	MG/L	0.32	0.22	-	< 0.01	0.07
ZINC	MG/L	0.026	0.131	-	0.026	0.045

Table D.5.15 Chemical analyses of groundwater, Green River, Utah, tailings site (Continued)

FORMATION OF COMPLETION: ALLUVIUM
HYDRAULIC FLOW RELATIONSHIP: UP GRADIENT

PARAMETER	UNIT OF MEASURE	LOCATION ID - SAMPLE ID AND LOG DATE: 707-01 07/15/82 PARAMETER VALUE+/-UNCERTAINTY	707-01 09/16/82 PARAMETER VALUE+/-UNCERTAINTY	707-01 11/23/82 PARAMETER VALUE+/-UNCERTAINTY	707-01 06/04/86 PARAMETER VALUE+/-UNCERTAINTY		707-01 09/07/86 PARAMETER VALUE+/-UNCERTAINTY	
ALKALINITY	MG/L CACO3	180.00	190.00	251.00	360.		176.	
ALUMINUM	MG/L	0.13	< 0.01	0.023	0.4		0.2	
AMMONIUM	MG/L	-	-	-	< 0.1		2.4	
ANTIMONY	MG/L	-	-	-	< 0.003		< 0.003	
ARSENIC	MG/L	< 0.01	< 0.01	0.006	< 0.01		< 0.01	
BALANCE	%	-	-	-	-1.20		0.18	
BARIUM	MG/L	< 0.10	0.015	< 0.05	0.3		< 0.1	
BICARBONATE	MG/L	220.00	232.00	306.00	-		-	
BORON	MG/L	-	-	-	0.6		0.4	
CADMIUM	MG/L	< 0.01	< 0.01	< 0.005	< 0.001		< 0.001	
CALCIUM	MG/L	450.00	470.00	460.00	488.		520.	
CHLORIDE	MG/L	430.00	345.00	561.00	312.		590.	
CHROMIUM	MG/L	< 0.01	< 0.01	< 0.005	0.05		0.02	
COBALT	MG/L	-	-	-	0.09		0.07	
CONDUCTANCE	UMHO/CM	8640.00	9650.00	9440.00	4900.		6200.	
COPPER	MG/L	0.057	0.021	< 0.005	0.05		0.04	
FLUORIDE	MG/L	1.00	< 1.00	< 1.00	0.6		0.7	
GROSS ALPHA	PCI/L	200.00	-	230.00	-		-	
GROSS BETA	PCI/L	-	-	-	-		-	
IRON	MG/L	< 0.05	< 0.05	< 0.05	0.18		0.04	
LEAD	MG/L	< 0.01	< 0.01	< 0.005	< 0.01		< 0.01	
MAGNESIUM	MG/L	360.00	225.00	361.00	368.		388.	
MANGANESE	MG/L	-	-	-	0.04		0.03	
MERCURY	MG/L	< 0.002	< 0.002	< 0.002	< 0.0002		< 0.0002	
MOLYBDENUM	MG/L	< 0.05	< 0.05	< 0.05	0.18		0.06	
NICKEL	MG/L	-	-	-	0.09		0.08	
NITRATE	MG/L	1.00	14.00	< 5.00	11.		120.	
NITRITE	MG/L	-	-	-	< 0.1		< 0.1	
ORG. CARBON	MG/L	-	-	-	-		41.	
PB-210	PCI/L	-	-	-	-		0.0	1.3
PH	SU	7.10	7.12	6.93	7.88		7.56	
PHOSPHATE	MG/L	-	-	-	< 0.1		< 0.1	
PO-210	PCI/L	-	-	-	-		0.0	0.6
POTASSIUM	MG/L	18.00	21.00	18.00	19.3		26.1	
RA-226	PCI/L	4.00	< 2.00	< 2.00	0.2	0.2	0.2	0.2
RA-228	PCI/L	8.00	< 2.00	-	1.1	0.9	0.0	0.8
SELENIUM	MG/L	0.13	0.104	0.124	< 0.005		0.069	
SILCON	MG/L	8.80	6.70	6.20	-		-	
SILICA	MG/L	-	-	-	4.		8.	
SILVER	MG/L	0.014	< 0.01	< 0.005	< 0.01		< 0.01	
SODIUM	MG/L	1880.00	1945.00	1790.00	1680.		2080.	
STRONTIUM	MG/L	-	-	-	7.2		6.	
SULFATE	MG/L	5830.00	5532.00	6210.00	5530.		6070	
SULFIDE	MG/L	-	-	-	-			
TEMPERATU	C - DEGREE	21.00	22.00	16.00	15.		19.	
TH-230	PCI/L	< 0.10	< 0.10	< 0.10	-		0.0	1.6

Table D.5.15 Chemical analyses of groundwater, Green River, Utah, tailings site (Continued)

FORMATION OF COMPLETION: ALLUVIUM
HYDRAULIC FLOW RELATIONSHIP: UP GRADIENT

PARAMETER	UNIT OF MEASURE	707-01 07/15/82 PARAMETER VALUE+/-UNCERTAINTY	707-01 09/16/82 PARAMETER VALUE+/-UNCERTAINTY	707-01 11/23/82 PARAMETER VALUE+/-UNCERTAINTY	707-01 06/04/86 PARAMETER VALUE+/-UNCERTAINTY	707-01 09/07/86 PARAMETER VALUE+/-UNCERTAINTY
TIN	MG/L	-	-	-	< 0.005	< 0.005
TOTAL SOLIDS	MG/L	9080.00	8680.00	9560.00	9420.	9480.
URANIUM	MG/L	0.016	0.025	0.03	0.0125	0.0090
VANADIUM	MG/L	< 0.05	< 0.05	< 0.05	0.29	0.16
ZINC	MG/L	-	-	-	0.023	0.023

Table D.5.15 Chemical analyses of groundwater, Green River, Utah, tailings site (Continued)

FORMATION OF COMPLETION: ALLUVIUM
HYDRAULIC FLOW RELATIONSHIP: UP GRADIENT

		LOCATION ID - SAMPLE ID AND LOG DATE								
		707-01 03/13/87		707-01 10/02/87		707-01 01/10/88		707-01 07/18/88		
PARAMETER	UNIT OF MEASURE	PARAMETER VALUE+/-UNCERTAINTY		PARAMETER VALUE+/-UNCERTAINTY		PARAMETER VALUE+/-UNCERTAINTY		PARAMETER VALUE+/-UNCERTAINTY		PARAMETER VALUE+/-UNCERTAINTY
ALKALINITY	MG/L CACO3	261.		159.		160.		166.		
ALUMINUM	MG/L	0.2		< 0.1		0.4		0.20		
AMMONIUM	MG/L	< 0.1		0.1		< 0.1		< 0.1		
ANTIMONY	MG/L	-		-		-		-		
ARSENIC	MG/L	-		< 0.01		0.01		0.025		
BALANCE	%	-		-		-		-		
BARIUM	MG/L	-		-		-		< 0.01		
BICARBONATE	MG/L	-		-		-		-		
BORON	MG/L	0.6		0.4		0.51		0.5		
CADMIUM	MG/L	-		-		-		0.006		
CALCIUM	MG/L	425.		440.		509.		407.		
CHLORIDE	MG/L	295.		300.		310.		330.		
CHROMIUM	MG/L	0.03		< 0.01		< 0.01		0.14		
COBALT	MG/L	-		-		-		-		
CONDUCTANCE	UMHO/CM	4400.		8500.		7480.		6500.		
COPPER	MG/L	-		-		-		0.01		
FLUORIDE	MG/L	0.5		0.6		0.47		0.5		
GROSS ALPHA	PCI/L	-		0.0	51.	7.	38.	0.	77.	
GROSS BETA	PCI/L	-		0.0	44.	17.	28.	32.	44.	
IRON	MG/L	0.05		< 0.03		0.2		0.10		
LEAD	MG/L	-		-		-		< 0.01		
MAGNESIUM	MG/L	355.		380.		416.		331.		
MANGANESE	MG/L	0.02		< 0.01		0.03		0.02		
MERCURY	MG/L	-		-		-		< 0.0002		
MOLYBDENUM	MG/L	< 0.1		< 0.01		0.20		0.08		
NICKEL	MG/L	-		-		-		-		
NITRATE	MG/L	140.		36.		8.7		25.		
NITRITE	MG/L	-		-		-		-		
ORG. CARBON	MG/L	-		4.		35.5		44.4		
PB-210	PCI/L	-		-		-		-		
PH	SU	7.77		7.4		7.5		7.56		
PHOSPHATE	MG/L	-		-		-		-		
PO-210	PCI/L	-		-		-		-		
POTASSIUM	MG/L	34.2		17.2		16.9		22.2		
RA-226	PCI/L	-		0.2	0.1	0.	0.1	0.0	0.1	
RA-228	PCI/L	-		1.5	1.0	0.	0.7	0.0	0.7	
SELENIUM	MG/L	0.034		0.12		0.324		0.231		
SILCON	MG/L	-		-		-		-		
SILICA	MG/L	-		-		-		-		
SILVER	MG/L	-		-		-		< 0.01		
SODIUM	MG/L	1920.		1790.		1680.		1830.		
STRONTIUM	MG/L	-		-		-		-		
SULFATE	MG/L	5830.		5700.		5820.		5720.		
SULFIDE	MG/L	-		-		-		< 0.1		
TEMPERATU	C - DEGREE	14.0		17.0		13.7		17.5		
TH-230	PCI/L	-		-		-		-		

Table D.5.15 Chemical analyses of groundwater, Green River, Utah, tailings site (Continued)

FORMATION OF COMPLETION: ALLUVIUM
HYDRAULIC FLOW RELATIONSHIP: UP GRADIENT

		LOCATION ID - SAMPLE ID AND LOG DATE			
		707-01 03/13/87	707-01 10/02/87	707-01 01/10/88	707-01 07/18/88
PARAMETER	UNIT OF MEASURE	PARAMETER VALUE+/-UNCERTAINTY	PARAMETER VALUE+/-UNCERTAINTY	PARAMETER VALUE+/-UNCERTAINTY	PARAMETER VALUE+/-UNCERTAINTY
TIN	MG/L	-	-	-	-
TOTAL SOLIDS	MG/L	9130.	9000.	9090.	8980.
URANIUM	MG/L	0.0109	0.016	0.0167	0.0081
VANADIUM	MG/L	-	< 0.01	0.07	0.07
ZINC	MG/L	-	< 0.005	0.007	< 0.005

Table D.5.15 Chemical analyses of groundwater, Green River, Utah, tailings site (Continued)

FORMATION OF COMPLETION: ALLUVIUM
HYDRAULIC FLOW RELATIONSHIP: ON-SITE

		LOCATION ID - SAMPLE ID AND LOG DATE							
		702-01 07/14/82	702-01 09/16/82	702-01 06/07/86		702-01 09/07/86		702-02 09/07/86	
PARAMETER	UNIT OF MEASURE	PARAMETER VALUE+/-UNCERTAINTY	PARAMETER VALUE+/-UNCERTAINTY	PARAMETER VALUE+/-UNCERTAINTY		PARAMETER VALUE+/-UNCERTAINTY		PARAMETER VALUE+/-UNCERTAINTY	
ALKALINITY	MG/L CACO3	245.00	270.00	237.		245.		245.	
ALUMINUM	MG/L	< 0.10	0.01	-		0.3		0.3	
AMMONIUM	MG/L	-	-	21.		24.		24.	
ANTIMONY	MG/L	-	-	-		< 0.003		< 0.003	
ARSENIC	MG/L	< 0.01	< 0.01	< 0.01		< 0.01		< 0.01	
BALANCE	%	-	-	-0.12		0.08		0.08	
BARIUM	MG/L	< 0.10	0.02	-		< 0.1		< 0.1	
BICARBONATE	MG/L	262.00	329.00	-		-		-	
BORON	MG/L	-	-	-		0.4		0.4	
CADMIUM	MG/L	< 0.01	< 0.01	-		< 0.001		< 0.001	
CALCIUM	MG/L	470.00	-	499.		520.		520.	
CHLORIDE	MG/L	120.00	101.00	93.		100.		100.	
CHROMIUM	MG/L	< 0.01	< 0.01	-		0.02		0.02	
COBALT	MG/L	-	-	-		< 0.05		< 0.05	
CONDUCTANCE	UMHO/CM	4900.00	5560.00	3500.		3900.		3900.	
COPPER	MG/L	0.027	0.011	-		0.03		0.03	
FLUORIDE	MG/L	2.00	2.00	0.8		0.9		0.9	
GROSS ALPHA	PCI/L	700.00	-	-		-		-	
GROSS BETA	PCI/L	-	-	-		-		-	
IRON	MG/L	< 0.05	< 0.05	0.07		< 0.03		< 0.03	
LEAD	MG/L	< 0.01	< 0.01	-		< 0.01		< 0.01	
MAGNESIUM	MG/L	160.00	150.00	122.		175.		175.	
MANGANESE	MG/L	-	-	0.37		0.47		0.47	
MERCURY	MG/L	< 0.002	< 0.002	-		< 0.0002		< 0.0002	
MOLYBDENUM	MG/L	< 0.05	< 0.05	0.27		0.09		0.10	
NICKEL	MG/L	-	-	-		0.05		0.05	
NITRATE	MG/L	2.00	14.00	3.		440.		440.	
NITRITE	MG/L	-	-	-		< 0.1		< 0.1	
ORG. CARBON	MG/L	-	-	-		70.		70.	
PB-210	PCI/L	-	-	-		4.4	1.6	3.5	1.6
PH	SU	7.20	6.95	7.34		6.81		6.81	
PHOSPHATE	MG/L	-	-	-		< 0.1		< 0.1	
PO-210	PCI/L	-	-	-		0.4	0.7	0.2	0.7
POTASSIUM	MG/L	14.00	14.00	11.7		14.8		14.8	
RA-226	PCI/L	< 2.00	< 2.00	0.	0.1	0.1	0.2	0.1	0.2
RA-228	PCI/L	< 5.00	< 2.00	0.	0.9	0.0	1.0	0.8	1.0
SELENIUM	MG/L	0.25	0.083	< 0.005		0.100		0.099	
SILCON	MG/L	10.60	-	-		-		-	
SILICA	MG/L	-	-	-		9.		9.	
SILVER	MG/L	0.01	< 0.01	-		< 0.01		< 0.01	
SODIUM	MG/L	830.00	901.00	798.		800.		800.	
STRONTIUM	MG/L	-	-	-		5.5		5.[illegible]	
SULFATE	MG/L	3260.00	3005.00	3070.		2980.		298[illegible]	
SULFIDE	MG/L	-	-	-		-			
TEMPERATU	C - DEGREE	26.00	16.00	15.		20.		20.	
TH-230	PCI/L	< 0.10	< 0.10	-		3.1	1.1	1.8	0.8

Table D.5.15 Chemical analyses of groundwater, Green River, Utah, tailings site (Continued)

FORMATION OF COMPLETION: ALLUVIUM
HYDRAULIC FLOW RELATIONSHIP: ON-SITE

		LOCATION ID - SAMPLE ID AND LOG DATE				
		702-01 07/14/82	702-01 09/16/82	702-01 06/07/86	702-01 09/07/86	702-02 09/07/86
PARAMETER	UNIT OF MEASURE	PARAMETER VALUE+/-UNCERTAINTY	PARAMETER VALUE+/-UNCERTAINTY	PARAMETER VALUE+/-UNCERTAINTY	PARAMETER VALUE+/-UNCERTAINTY	PARAMETER VALUE+/-UNCERTAINTY
TIN	MG/L	-	-	-	< 0.005	< 0.005
TOTAL SOLIDS	MG/L	4990.00	4870.00	5050.	5090.	5100.
URANIUM	MG/L	0.90	0.70	0.739	1.49	1.49
VANADIUM	MG/L	< 0.05	< 0.05	-	0.24	-
ZINC	MG/L	-	-	-	0.023	0.023

Table D.5.15 Chemical analyses of groundwater, Green River, Utah, tailings site (Continued)

FORMATION OF COMPLETION: ALLUVIUM
HYDRAULIC FLOW RELATIONSHIP: ON-SITE

		LOCATION ID - SAMPLE ID AND LOG DATE									
		702-03 09/07/86		702-04 09/07/86		702-05 09/07/86		702-01 03/13/87		702-02 03/13/87	
PARAMETER	UNIT OF MEASURE	PARAMETER VALUE+/-UNCERTAINTY		PARAMETER VALUE+/-UNCERTAINTY		PARAMETER VALUE+/-UNCERTAINTY		PARAMETER VALUE+/-UNCERTAINTY		PARAMETER VALUE+/-UNCERTAINTY	
ALKALINITY	MG/L CACO3	245.		245.		245.		271.		271.	
ALUMINUM	MG/L	0.3		0.3		0.3		0.1		0.2	
AMMONIUM	MG/L	24.		24.		24.		18.		19.	
ANTIMONY	MG/L	< 0.003		< 0.003		< 0.003		-		-	
ARSENIC	MG/L	< 0.01		< 0.01		< 0.01		-		-	
BALANCE	%	0.08		0.08		0.08		-		-	
BARIUM	MG/L	< 0.1		< 0.1		< 0.1		-		-	
BICARBONATE	MG/L	-		-		-		-		-	
BORON	MG/L	0.4		0.4		0.4		0.7		0.7	
CADMIUM	MG/L	< 0.001		< 0.001		< 0.001		-		-	
CALCIUM	MG/L	520.		520.		520.		475.		475.	
CHLORIDE	MG/L	100.		100.		100.		76.		76.	
CHROMIUM	MG/L	0.02		0.02		0.02		0.02		0.02	
COBALT	MG/L	< 0.05		< 0.05		< 0.05		-		-	
CONDUCTANCE	UMHO/CM	3900.		3900.		3900.		2650.		2650.	
COPPER	MG/L	0.03		0.03		0.03		-		-	
FLUORIDE	MG/L	0.9		0.9		0.9		0.7		0.7	
GROSS ALPHA	PCI/L	-		-		-		-		-	
GROSS BETA	PCI/L	-		-		-		-		-	
IRON	MG/L	< 0.03		< 0.03		< 0.03		0.05		0.04	
LEAD	MG/L	< 0.01		< 0.01		< 0.01		-		-	
MAGNESIUM	MG/L	175.		175.		175.		150.		150.	
MANGANESE	MG/L	0.47		0.47		0.47		0.43		0.42	
MERCURY	MG/L	< 0.0002		< 0.0002		< 0.0002		-		-	
MOLYBDENUM	MG/L	0.09		0.10		0.10		< 0.1		< 0.1	
NICKEL	MG/L	0.05		0.05		0.05		-		-	
NITRATE	MG/L	440.		440.		440.		142.		142.	
NITRITE	MG/L	< 0.1		< 0.1		< 0.1		-		-	
ORG. CARBON	MG/L	70.		70.		70.		-		-	
PB-210	PCI/L	4.0	1.4	4.2	1.9	5.2	1.7	-		-	
PH	SU	6.81		6.81		6.81		6.86		6.86	
PHOSPHATE	MG/L	< 0.1		< 0.1		< 0.1		-		-	
PO-210	PCI/L	0.2	1.2	0.0	0.6	0.3	0.7	-		-	
POTASSIUM	MG/L	14.8		14.8		14.8		12.4		12.5	
RA-226	PCI/L	0.1	0.2	0.1	0.2	0.2	0.2	-		-	
RA-228	PCI/L	0.0	1.0	0.0	0.8	0.0	0.8	-		-	
SELENIUM	MG/L	0.099		0.100		0.100		0.049		0.050	
SILCON	MG/L	-		-		-		-		-	
SILICA	MG/L	9.		9.		9.		-		-	
SILVER	MG/L	< 0.01		< 0.01		< 0.01		-		-	
SODIUM	MG/L	800.		800.		800.		767.		767.	
STRONTIUM	MG/L	5.5		5.5		5.5		-		-	
SULFATE	MG/L	2980.		2980.		2980.		2950.		2950.	
SULFIDE	MG/L	-		-		-		-		-	
TEMPERATURE	C - DEGREE	20.0		20.		20.		14.0		14.0	
TH-230	PCI/L	1.6	0.8	1.9	0.9	2.8	1.0	-		-	

Table D.5.15 Chemical analyses of groundwate., Green River, Utah, tailings site (Continued)

FORMATION OF COMPLETION: ALLUVIUM
HYDRAULIC FLOW RELATIONSHIP: ON-SITE

		LOCATION ID - SAMPLE ID AND LOG DATE				
		702-03 09/07/86	702-04 09/07/86	702-05 09/07/86	702-01 03/13/87	702-02 03/13/87
PARAMETER	UNIT OF MEASURE	PARAMETER VALUE+/-UNCERTAINTY	PARAMETER VALUE+/-UNCERTAINTY	PARAMETER VALUE+/-UNCERTAINTY	PARAMETER VALUE+/-UNCERTAINTY	PARAMETER VALUE+/-UNCERTAINTY
TIN	MG/L	< 0.005	< 0.005	< 0.005	-	-
TOTAL SOLIDS	MG/L	5090.	5100.	5090.	4860.	4860.
URANIUM	MG/L	1.22	1.10	1.16	1.96	1.90
VANADIUM	MG/L	0.24	0.24	0.24	-	-
ZINC	MG/L	0.023	0.023	0.023	-	-

Table D.5.15 Chemical analyses of groundwater, Green River, Utah, tailings site (Continued)

FORMATION OF COMPLETION: ALLUVIUM
HYDRAULIC FLOW RELATIONSHIP: ON-SITE

		LOCATION ID - SAMPLE ID AND LOG DATE														
		702-03 03/13/87			702-04 03/13/87			702-05 03/13/87			702-01 10/06/87			702-01 01/12/88		
PARAMETER	UNIT OF MEASURE	PARAMETER VALUE+/-UNCERTAINTY			PARAMETER VALUE+/-UNCERTAINTY			PARAMETER VALUE+/-UNCERTAINTY			PARAMETER VALUE+/-UNCERTAINTY			PARAMETER VALUE+/-UNCERTAINTY		
ALKALINITY	MG/L CACO3		271.			271.			271.			265.			247.	
ALUMINUM	MG/L		0.2			0.2			0.2		<	0.1			0.39	
AMMONIUM	MG/L		19.			18.			19.			42.			24.8	
ANTIMONY	MG/L		-			-			-			-			-	
ARSENIC	MG/L		-			-			-		<	0.01		<	0.01	
BALANCE	%		-			-			-			-			-	
BARIUM	MG/L		-			-			-			-			-	
BICARBONATE	MG/L		-			-			-			-			-	
BORON	MG/L		0.7			0.7			0.7			0.4			0.44	
CADMIUM	MG/L		-			-			-			-			-	
CALCIUM	MG/L		474.			474.			475.			460.			449.	
CHLORIDE	MG/L		76.			76.			76.			110.			86.	
CHROMIUM	MG/L		0.02			0.03			0.03		<	0.01			0.02	
COBALT	MG/L		-			-			-			-			-	
CONDUCTANCE	UMHO/CM		2650.			2650.			2650.			4800.			4090.	
COPPER	MG/L		-			-			-			-			-	
FLUORIDE	MG/L		0.7			0.7			0.7			0.8			0.76	
GROSS ALPHA	PCI/L		-			-			-			450.	90.		690.	60.
GROSS BETA	PCI/L		-			-			-			147.	44.		340.	20.
IRON	MG/L		0.04			0.03			0.04		<	0.03			0.24	
LEAD	MG/L		-			-			-			-			-	
MAGNESIUM	MG/L		150.			151.			150.			140.			126.	
MANGANESE	MG/L		0.41			0.42			0.42			0.27			0.28	
MERCURY	MG/L		-			-			-			-			-	
MOLYBDENUM	MG/L	<	0.1		<	0.1		<	0.1		<	0.01			0.10	
NICKEL	MG/L		-			-			-			-			-	
NITRATE	MG/L		142.			142.			142.			50.			97.5	
NITRITE	MG/L		-			-			-			-			-	
ORG. CARBON	MG/L		-			-			-			8.			79.4	
PB-210	PCI/L		-			-			-			-			-	
PH	SU		6.86			6.86			6.86			6.90			6.85	
PHOSPHATE	MG/L		-			-			-			-			-	
PO-210	PCI/L		-			-			-			-			-	
POTASSIUM	MG/L		12.5			12.5			12.5			2.7			10.4	
RA-226	PCI/L		-			-			-			0.3	0.2		0.	0.1
RA-228	PCI/L		-			-			-			2.8	1.0		0.3	0.7
SELENIUM	MG/L		0.049			0.049			0.049			0.040			0.349	
SILCON	MG/L		-			-			-			-			-	
SILICA	MG/L		-			-			-			-			-	
SILVER	MG/L		-			-			-			-			-	
SODIUM	MG/L		768.			767.			768.			890.			806.	
STRONTIUM	MG/L		-			-			-			-			-	
SULFATE	MG/L		2950.			2950.			2950.			3100.			2900.	
SULFIDE	MG/L		-			-			-			-			-	
TEMPERATURE	C - DEGREE		14.0			14.0			14.0			16.0			14.7	
TH-230	PCI/L		-			-			-			-			-	

Table D.5.15 Chemical analyses of groundwate. , Green River, Utah, tailings site (Continued)

FORMATION OF COMPLETION: ALLUVIUM
HYDRAULIC FLOW RELATIONSHIP: ON-SITE

		LOCATION ID - SAMPLE ID AND LOG DATE				
		702-03 03/13/87	702-04 03/13/87	702-05 03/13/87	702-01 10/06/87	702-01 01/12/88
PARAMETER	UNIT OF MEASURE	PARAMETER VALUE+/-UNCERTAINTY	PARAMETER VALUE+/-UNCERTAINTY	PARAMETER VALUE+/-UNCERTAINTY	PARAMETER VALUE+/-UNCERTAINTY	PARAMETER VALUE+/-UNCERTAINTY
TIN	MG/L	-	-	-	-	-
TOTAL SOLIDS	MG/L	4860.	4860.	4860.	5280.	4820.
URANIUM	MG/L	2.07	2.15	2.23	0.79	1.09
VANADIUM	MG/L	-	-	-	< 0.01	0.07
ZINC	MG/L	-	-	-	0.009	0.006

Table D.5.15 Chemical analyses of groundwater, Green River, Utah, tailings site (Continued)

FORMATION OF COMPLETION: ALLUVIUM
HYDRAULIC FLOW RELATIONSHIP: ON-SITE

		LOCATION ID - SAMPLE ID AND LOG DATE									
		704-01 07/14/82		704-01 06/05/86		704-01 09/07/86		704-01 03/13/87		704-01 01/12/88	
PARAMETER	UNIT OF MEASURE	PARAMETER VALUE+/-UNCERTAINTY		PARAMETER VALUE+/-UNCERTAINTY		PARAMETER VALUE+/-UNCERTAINTY		PARAMETER VALUE+/-UNCERTAINTY		PARAMETER VALUE+/-UNCERTAINTY	
ALKALINITY	MG/L CACO3	400.00		368.		390.		376.		350.	
ALUMINUM	MG/L	< 0.10		-		0.3		0.2		0.37	
AMMONIUM	MG/L	-		41.		38.		36.		32.3	
ANTIMONY	MG/L	-		-		< 0.003		-		-	
ARSENIC	MG/L	< 0.01		< 0.01		< 0.01		-		< 0.01	
BALANCE	%	-		-0.21		-0.09		-		-	
BARIUM	MG/L	-		-		< 0.1		-		-	
BICARBONATE	MG/L	488.00		-		-		-		-	
BORON	MG/L	-		-		0.4		0.5		0.55	
CADMIUM	MG/L	-		-		< 0.001		-		-	
CALCIUM	MG/L	450.00		483.		534.		433.		419.	
CHLORIDE	MG/L	300.00		258.		480.		225.		220.	
CHROMIUM	MG/L	-		-		0.02		0.02		0.02	
COBALT	MG/L	-		-		0.06		-		-	
CONDUCTANCE	UMHO/CM	8160.00		2850.		6100.		4050.		6780.	
COPPER	MG/L	-		-		0.04		-		-	
FLUORIDE	MG/L	2.00		1.1		1.2		1.1		1.09	
GROSS ALPHA	PCI/L	-		200.	110.	-		-		190.	60.
GROSS BETA	PCI/L	-		180.	60.	-		-		150.	30.
IRON	MG/L	< 0.05		0.09		0.03		0.05		0.2	
LEAD	MG/L	-		-		< 0.01		-		-	
MAGNESIUM	MG/L	280.00		231.		247.		220.		205.	
MANGANESE	MG/L	-		0.98		0.48		0.52		0.34	
MERCURY	MG/L	-		-		< 0.0002		-		-	
MOLYBDENUM	MG/L	< 0.05		0.25		0.14		< 0.1		0.17	
NICKEL	MG/L	-		-		0.05		-		-	
NITRATE	MG/L	4.00		20.		350.		167.		57.	
NITRITE	MG/L	-		-		< 0.1		-		-	
ORG. CARBON	MG/L	-		104.		70.		-		112.	
PB-210	PCI/L	-		1.	0.9	1.5	1.7	-		-	
PH	SU	7.90		7.16		7.11		7.15		7.0	
PHOSPHATE	MG/L	-		-		< 0.1		-		-	
PO-210	PCI/L	-		0.4	0.6	0.0	0.6	-		-	
POTASSIUM	MG/L	16.00		18.7		20.0		32.0		13.8	
RA-226	PCI/L	< 2.00		-		0.0	0.2	-		0.	0.1
RA-228	PCI/L	-		-		0.0	1.1	-		0.1	0.7
SELENIUM	MG/L	0.012		< 0.005		0.092		< 0.002		0.223	
SILCON	MG/L	-		-		-		-		-	
SILICA	MG/L	-		-		10.		-		-	
SILVER	MG/L	-		-		< 0.01		-		-	
SODIUM	MG/L	1550.00		1290.		2010.		1840.		1690.	
STRONTIUM	MG/L	-		-		6.6		-		-	
SULFATE	MG/L	4580.00		4200.		5290.		5150.		4840	
SULFIDE	MG/L	-		-		-		-		-	
TEMPERATURE	C - DEGREE	24.00		15.		22.		14.5		13.[illegible]	
TH-230	PCI/L	-		0.	0.2	1.1	0.7	-		-	

Table D.5.15 Chemical analyses of groundwate., Green River, Utah, tailings site (Continued)

FORMATION OF COMPLETION: ALLUVIUM
HYDRAULIC FLOW RELATIONSHIP: ON-SITE

		LOCATION ID - SAMPLE ID AND LOG DATE				
		704-01 07/14/82	704-01 06/05/86	704-01 09/07/86	704-01 03/13/87	704-01 01/12/88
PARAMETER	UNIT OF MEASURE	PARAMETER VALUE+/-UNCERTAINTY	PARAMETER VALUE+/-UNCERTAINTY	PARAMETER VALUE+/-UNCERTAINTY	PARAMETER VALUE+/-UNCERTAINTY	PARAMETER VALUE+/-UNCERTAINTY
TIN	MG/L	-	-	< 0.005	-	-
TOTAL SOLIDS	MG/L	7420.00	8580.	8490.	8090.	7810.
URANIUM	MG/L	0.70	0.487	0.288	0.254	0.411
VANADIUM	MG/L	< 0.05	-	0.24	-	0.07
ZINC	MG/L	-	-	0.025	-	0.012

Table D.5.15 Chemical analyses of groundwater, Green River, Utah, tailings site (Continued)

FORMATION OF COMPLETION: ALLUVIUM
HYDRAULIC FLOW RELATIONSHIP: ON-SITE

		LOCATION ID - SAMPLE ID AND LOG DATE				
		705-01 07/15/82	705-01 09/16/82	705-01 06/06/86	705-01 09/07/86	705-01 02/24/87
PARAMETER	UNIT OF MEASURE	PARAMETER VALUE+/-UNCERTAINTY	PARAMETER VALUE+/-UNCERTAINTY	PARAMETER VALUE+/-UNCERTAINTY	PARAMETER VALUE+/-UNCERTAINTY	PARAMETER VALUE+/-UNCERTAINTY
ALKALINITY	MG/L CACO3	250.00	244.00	294.	298.	346.
ALUMINUM	MG/L	0.27	< 0.01	-	0.4	< 0.1
AMMONIUM	MG/L	-	-	27.	41.	8.0
ANTIMONY	MG/L	-	-	-	< 0.003	-
ARSENIC	MG/L	< 0.01	< 0.01	< 0.01	< 0.01	-
BALANCE	%	-	-	-0.09	-0.04	-
BARIUM	MG/L	-	0.014	-	< 0.1	-
BICARBONATE	MG/L	305.00	298.00	-	-	-
BORON	MG/L	-	-	-	0.6	0.35
CADMIUM	MG/L	-	< 0.01	-	< 0.001	-
CALCIUM	MG/L	450.00	490.00	456.	483.	413.
CHLORIDE	MG/L	400.00	324.00	321.	140.	369.
CHROMIUM	MG/L	-	< 0.01	-	0.02	0.04
COBALT	MG/L	-	-	-	0.08	-
CONDUCTANCE	UMHO/CM	15400.00	8960.00	4900.	6200.	4700.
COPPER	MG/L	-	0.024	-	0.04	-
FLUORIDE	MG/L	1.00	< 1.00	0.8	0.8	0.63
GROSS ALPHA	PCI/L	-	-	-	-	-
GROSS BETA	PCI/L	-	-	-	-	-
IRON	MG/L	< 0.05	< 0.05	0.07	0.06	0.05
LEAD	MG/L	-	< 0.01	-	< 0.01	-
MAGNESIUM	MG/L	280.00	330.00	268.	316.	315.
MANGANESE	MG/L	-	-	0.02	0.03	0.03
MERCURY	MG/L	-	< 0.002	-	< 0.0002	-
MOLYBDENUM	MG/L	< 0.05	< 0.05	0.24	0.16	< 0.1
NICKEL	MG/L	-	-	-	0.10	-
NITRATE	MG/L	1.00	6.00	5.	22.	8.9
NITRITE	MG/L	-	-	-	< 0.1	-
ORG. CARBON	MG/L	-	-	-	-	-
PB-210	PCI/L	-	-	-	-	-
PH	SU	7.20	7.13	7.46	7.31	7.34
PHOSPHATE	MG/L	-	-	-	< 0.1	-
PO-210	PCI/L	-	-	-	-	-
POTASSIUM	MG/L	16.00	18.00	19.4	20.4	17.0
RA-226	PCI/L	< 2.00	< 2.00	-	-	-
RA-228	PCI/L	-	< 2.00	-	-	-
SELENIUM	MG/L	0.023	0.014	< 0.005	< 0.005	0.41
SILCON	MG/L	-	6.70	-	-	-
SILICA	MG/L	-	-	-	7.	-
SILVER	MG/L	-	< 0.01	-	< 0.01	-
SODIUM	MG/L	1680.00	1840.00	2100.	2090.	2450.
STRONTIUM	MG/L	-	-	-	6.6	-
SULFATE	MG/L	5410.00	5021.00	5930.	6420.	659[illegible]
SULFIDE	MG/L	-	-	-	-	[illegible]
TEMPERAT[illegible]	C - DEGREE	18.00	19.00	15.	18.	14.
TH-230	PCI/L	-	< 0.10	-	-	-

Table D.5.15 Chemical analyses of groundwater, Green River, Utah, tailings site (Continued)

FORMATION OF COMPLETION: ALLUVIUM
HYDRAULIC FLOW RELATIONSHIP: ON-SITE

		LOCATION ID - SAMPLE ID AND LOG DATE				
		705-01 07/15/82	705-01 09/16/82	705-01 06/06/86	705-01 09/07/86	705-01 02/24/87
PARAMETER	UNIT OF MEASURE	PARAMETER VALUE+/-UNCERTAINTY	PARAMETER VALUE+/-UNCERTAINTY	PARAMETER VALUE+/-UNCERTAINTY	PARAMETER VALUE+/-UNCERTAINTY	PARAMETER VALUE+/-UNCERTAINTY
TIN	MG/L	-	-	-	< 0.005	-
TOTAL SOLIDS	MG/L	8390.00	8480.00	9870.	9730.	10400.
URANIUM	MG/L	0.09	0.118	0.0419	0.0485	0.0578
VANADIUM	MG/L	< 0.05	< 0.05	-	0.21	-
ZINC	MG/L	-	-	-	0.027	-

Table D.5.15 Chemical analyses of groundwater, Green River, Utah, tailings site (Continued)

FORMATION OF COMPLETION: ALLUVIUM
HYDRAULIC FLOW RELATIONSHIP: ON-SITE

		LOCATION ID - SAMPLE ID AND LOG DATE									
		705-01 10/06/87		705-01 01/12/88		705-01 07/21/88		808-01 10/23/87		808-02 10/23/87	
PARAMETER	UNIT OF MEASURE	PARAMETER VALUE	+/-UNCERTAINTY	PARAMETER VALUE	+/-UNCERTAINTY	PARAMETER VALUE	+/-UNCERTAINTY	PARAMETER VALUE	+/-UNCERTAINTY	PARAMETER VALUE	+/-UNCERTAINTY
ALKALINITY	MG/L CACO3	302.		335.		267.		270.		270.	
ALUMINUM	MG/L	< 0.1		0.37		0.19		< 0.1		< 0.1	
AMMONIUM	MG/L	42.		36.1		35.		19.1		18.7	
ANTIMONY	MG/L	-		-		-		-		-	
ARSENIC	MG/L	< 0.01		0.02		0.018		< 0.01		< 0.01	
BALANCE	%	-		-		-		-		-	
BARIUM	MG/L	-		-		< 0.01		-		-	
BICARBONATE	MG/L	-		-		-		-		-	
BORON	MG/L	0.4		0.55		0.47		0.4		0.4	
CADMIUM	MG/L	-		-		0.072		-		-	
CALCIUM	MG/L	420.		425.		366.		530.		520.	
CHLORIDE	MG/L	360.		370.		320.		101.		100.	
CHROMIUM	MG/L	< 0.01		0.02		0.13		< 0.01		< 0.01	
COBALT	MG/L	-		-		-		-		-	
CONDUCTANCE	UMHO/CM	9800.		9070.		6500.		4500.		4500.	
COPPER	MG/L	-		-		0.01		-		-	
FLUORIDE	MG/L	0.8		0.66		0.7		0.6		0.7	
GROSS ALPHA	PCI/L	115.	68.	59.	44.	0.	73.	980.	120.	950.	130.
GROSS BETA	PCI/L	76.	57.	93.	33.	26.	40.	310.	56.	450.	88.
IRON	MG/L	< 0.03		0.22		0.09		< 0.03		< 0.03	
LEAD	MG/L	-		-		< 0.01		-		-	
MAGNESIUM	MG/L	310.		315.		248.		165.		161.	
MANGANESE	MG/L	< 0.01		0.03		0.02		0.51		0.45	
MERCURY	MG/L	-		-		< 0.0002		-		-	
MOLYBDENUM	MG/L	0.03		0.21		0.09		< 0.01		< 0.01	
NICKEL	MG/L	-		-		-		-		-	
NITRATE	MG/L	11.5		3.5		1.9		137.		143.	
NITRITE	MG/L	-		-		-		-		-	
ORG. CARBON	MG/L	5.		97.3		74.6		12.		13.	
PB-210	PCI/L	-		-		-		-		-	
PH	SU	7.2		7.15		7.26		6.8		6.8	
PHOSPHATE	MG/L	-		-		-		-		-	
PO-210	PCI/L	-		-		-		-		-	
POTASSIUM	MG/L	16.3		17.7		19.7		10.5		10.5	
RA-226	PCI/L	0.5	0.3	0.1	0.1	0.0	0.1	0.0	0.1	0.2	0.1
RA-228	PCI/L	1.2	0.9	0.1	0.8	0.5	0.7	0.1	0.9	0.2	1.0
SELENIUM	MG/L	< 0.005		0.367		0.137		0.32		0.31	
SILCON	MG/L	-		-		-		-		-	
SILICA	MG/L	-		-		-		-		-	
SILVER	MG/L	-		-		0.02		-		-	
SODIUM	MG/L	2300.		2540.		1920.		720.		700.	
STRONTIUM	MG/L	-		-		-		-		-	
SULFATE	MG/L	5800.		6890.		5950.		3000.		3000.	
SULFIDE	MG/L	-		-		< 0.1		-		-	
TEMPERATURE	C - DEGREE	16.5		15.0		16.0		17.0		17.0	
TH-230	PCI/L	-		-		-		-		-	

Table D.5.15 Chemical analyses of groundwater, Green River, Utah, tailings site (Continued)

FORMATION OF COMPLETION: ALLUVIUM
HYDRAULIC FLOW RELATIONSHIP: ON-SITE

		LOCATION ID - SAMPLE ID AND LOG DATE				
		705-01 10/06/87	705-01 01/12/88	705-01 07/21/88	808-01 10/23/87	808-02 10/23/87
PARAMETER	UNIT OF MEASURE	PARAMETER VALUE+/-UNCERTAINTY	PARAMETER VALUE+/-UNCERTAINTY	PARAMETER VALUE+/-UNCERTAINTY	PARAMETER VALUE+/-UNCERTAINTY	PARAMETER VALUE+/-UNCERTAINTY
TIN	MG/L	-	-	-	-	-
TOTAL SOLIDS	MG/L	10400.	10800.	9230.	4980.	4960.
URANIUM	MG/L	0.081	0.0617	0.0521	1.31	1.64
VANADIUM	MG/L	< 0.01	0.07	0.07	< 0.01	< 0.01
ZINC	MG/L	< 0.005	0.007	< 0.005	0.036	0.042

Table D.5.15 Chemical analyses of groundwater, Green River, Utah, tailings site (Continued)

FORMATION OF COMPLETION: ALLUVIUM
HYDRAULIC FLOW RELATIONSHIP: ON-SITE

		LOCATION ID - SAMPLE ID AND LOG DATE									
		808-03 10/23/87		808-04 10/23/87		808-05 10/23/87		808-01 01/11/88		808-02 01/11/88	
PARAMETER	UNIT OF MEASURE	PARAMETER VALUE+/-UNCERTAINTY		PARAMETER VALUE+/-UNCERTAINTY		PARAMETER VALUE+/-UNCERTAINTY		PARAMETER VALUE+/-UNCERTAINTY		PARAMETER VALUE+/-UNCERTAINTY	
ALKALINITY	MG/L CACO3	270.		270.		270.		226.		226.	
ALUMINUM	MG/L	< 0.1		< 0.1		< 0.1		0.38		0.39	
AMMONIUM	MG/L	18.7		18.9		18.9		19.1		18.6	
ANTIMONY	MG/L	-		-		-		-		-	
ARSENIC	MG/L	< 0.01		< 0.01		< 0.01		0.01		< 0.01	
BALANCE	%	-		-		-		-		-	
BARIUM	MG/L	-		-		-		-		-	
BICARBONATE	MG/L	-		-		-		-		-	
BORON	MG/L	0.4		0.3		0.4		0.47		0.45	
CADMIUM	MG/L	-		-		-		-		-	
CALCIUM	MG/L	510.		460.		490.		460.		452.	
CHLORIDE	MG/L	99.		98.		102.		83.		78.	
CHROMIUM	MG/L	< 0.01		< 0.01		< 0.01		0.01		0.01	
COBALT	MG/L	-		-		-		-		-	
CONDUCTANCE	UMHO/CM	4500.		4500.		4500.		4020.		4020.	
COPPER	MG/L	-		-		-		-		-	
FLUORIDE	MG/L	0.7		0.7		0.8		0.72		0.73	
GROSS ALPHA	PCI/L	700.	115.	1020.	160.	840.	110.	950.	60.	900.	60.
GROSS BETA	PCI/L	450.	75.	410.	180.	370.	59.	480.	20.	500.	20.
IRON	MG/L	< 0.03		< 0.03		< 0.03		0.2		0.2	
LEAD	MG/L	-		-		-		-		-	
MAGNESIUM	MG/L	157.		156.		150.		133.		130.	
MANGANESE	MG/L	0.46		0.45		0.49		0.56		0.55	
MERCURY	MG/L	-		-		-		-		-	
MOLYBDENUM	MG/L	< 0.01		< 0.01		< 0.01		0.10		0.11	
NICKEL	MG/L	-		-		-		-		-	
NITRATE	MG/L	129.		142.		131.		70.		69.	
NITRITE	MG/L	-		-		-		-		-	
ORG. CARBON	MG/L	12.		12.		8.		76.		77.2	
PB-210	PCI/L	-		-		-		-		-	
PH	SU	6.8		6.8		6.8		7.0		7.0	
PHOSPHATE	MG/L	-		-		-		-		-	
PO-210	PCI/L	-		-		-		-		-	
POTASSIUM	MG/L	10.5		10.5		10.5		10.5		10.5	
RA-226	PCI/L	0.1	0.1	0.0	0.2	0.0	0.1	0.	0.1	0.	0.1
RA-228	PCI/L	0.0	0.9	7.5	1.6	0.0	0.9	0.1	0.8	0.4	0.8
SELENIUM	MG/L	0.35		0.30		0.35		0.502		0.428	
SILCON	MG/L	-		-		-		-		-	
SILICA	MG/L	-		-		-		-		-	
SILVER	MG/L	-		-		-		-		-	
SODIUM	MG/L	690.		670.		660.		702.		593.	
STRONTIUM	MG/L	-		-		-		-		-	
SULFATE	MG/L	3000.		3000.		3000.		2560.		2560.	
SULFIDE	MG/L	-		-		-		-		-	
TEMPERATURE	C - DEGREE	17.0		17.0		17.0		14.1		14.1	
TH-230	PCI/L	-		-		-		-		-	

Table D.5.15 Chemical analyses of groundwater, Green River, Utah, tailings site (Continued)

FORMATION OF COMPLETION: ALLUVIUM
HYDRAULIC FLOW RELATIONSHIP: ON-SITE

		LOCATION ID - SAMPLE ID AND LOG DATE				
		808-03 10/23/87	808-04 10/23/87	808-05 10/23/87	808-01 01/11/88	808-02 01/11/88
PARAMETER	UNIT OF MEASURE	PARAMETER VALUE+/-UNCERTAINTY	PARAMETER VALUE+/-UNCERTAINTY	PARAMETER VALUE+/-UNCERTAINTY	PARAMETER VALUE+/-UNCERTAINTY	PARAMETER VALUE+/-UNCERTAINTY
TIN	MG/L	-	-	-	-	-
TOTAL SOLIDS	MG/L	4970.	4990.	4960.	4610.	4640.
URANIUM	MG/L	1.23	1.67	1.67	1.67	1.80
VANADIUM	MG/L	< 0.01	< 0.01	< 0.01	0.06	0.06
ZINC	MG/L	0.029	0.028	0.035	0.016	0.014

Table D.5.15 Chemical analyses of groundwater, Green River, Utah, tailings site (Continued)

FORMATION OF COMPLETION: ALLUVIUM
HYDRAULIC FLOW RELATIONSHIP: ON-SITE

		LOCATION ID - SAMPLE ID AND LOG DATE									
		808-03 01/11/88		808-04 01/11/88		808-05 01/11/88					
PARAMETER	UNIT OF MEASURE	PARAMETER VALUE+/-UNCERTAINTY		PARAMETER VALUE+/-UNCERTAINTY		PARAMETER VALUE+/-UNCERTAINTY		PARAMETER VALUE+/-UNCERTAINTY		PARAMETER VALUE+/-UNCERTAINTY	
ALKALINITY	MG/L CACO3	226.		226.		226.					
ALUMINUM	MG/L	0.4		0.4		0.4					
AMMONIUM	MG/L	18.6		18.6		18.6					
ANTIMONY	MG/L	-		-		-					
ARSENIC	MG/L	0.01		< 0.01		< 0.01					
BALANCE	%	-		-		-					
BARIUM	MG/L	-		-		-					
BICARBONATE	MG/L	-		-		-					
BORON	MG/L	0.43		0.42		0.45					
CADMIUM	MG/L	-		-		-					
CALCIUM	MG/L	458.		455.		456.					
CHLORIDE	MG/L	78.		78.		78.					
CHROMIUM	MG/L	0.01		0.01		0.01					
COBALT	MG/L	-		-		-					
CONDUCTANCE	UMHO/CM	4020.		4020.		4020.					
COPPER	MG/L	-		-		-					
FLUORIDE	MG/L	0.72		0.7		0.7					
GROSS ALPHA	PCI/L	920.	60.	940.	60.	1200.	100.				
GROSS BETA	PCI/L	490.	20.	490.	20.	530.	20.				
IRON	MG/L	0.2		0.19		0.2					
LEAD	MG/L	-		-		-					
MAGNESIUM	MG/L	132.		131.		132.					
MANGANESE	MG/L	0.54		0.53		0.54					
MERCURY	MG/L	-		-		-					
MOLYBDENUM	MG/L	0.15		0.11		0.10					
NICKEL	MG/L	-		-		-					
NITRATE	MG/L	68.		63.		67.					
NITRITE	MG/L	-		-		-					
ORG. CARBON	MG/L	76.6		76.5		75.5					
PB-210	PCI/L	-		-		-					
PH	SU	7.0		7.0		7.0					
PHOSPHATE	MG/L	-		-		-					
PO-210	PCI/L	-		-		-					
POTASSIUM	MG/L	10.6		10.2		10.3					
RA-226	PCI/L	0.	0.1	0.2	0.1	0.	0.1				
RA-228	PCI/L	0.	0.7	0.	0.7	0.	0.8				
SELENIUM	MG/L	0.441		0.760		0.725					
SILCON	MG/L	-		-		-					
SILICA	MG/L	-		-		-					
SILVER	MG/L	-		-		-					
SODIUM	MG/L	702.		699.		691.					
STRONTIUM	MG/L	-		-		-					
SULFATE	MG/L	2570.		2560.		2570.					
SULFIDE	MG/L	-		-		-					
TEMPERATURE	C - DEGREE	14.1		14.1		14.1					
TH-230	PCI/L	-		-		-					

Table D.5.15 Chemical analyses of groundwater, Green River, Utah, tailings site (Continued)

FORMATION OF COMPLETION: ALLUVIUM
HYDRAULIC FLOW RELATIONSHIP: ON-SITE

		LOCATION ID - SAMPLE ID AND LOG DATE		
		808-03 01/11/88	808-04 01/11/88	808-05 01/11/88
PARAMETER	UNIT OF MEASURE	PARAMETER VALUE+/-UNCERTAINTY	PARAMETER VALUE+/-UNCERTAINTY	PARAMETER VALUE+/-UNCERTAINTY
TIN	MG/L	-	-	-
TOTAL SOLIDS	MG/L	4640.	4620.	4640.
URANIUM	MG/L	1.72	1.80	1.69
VANADIUM	MG/L	0.07	0.06	0.06
ZINC	MG/L	0.014	0.012	0.014

MAPPER DATA FILE NAME: GRN01*UDPGW0102183

Table D.5.15 Chemical analyses of groundwater, Green River, Utah, tailings site (Continued)

FORMATION OF COMPLETION: ALLUVIUM
HYDRAULIC FLOW RELATIONSHIP: CROSS GRADIENT

		LOCATION ID - SAMPLE ID AND LOG DATE					
		708-01 09/15/82	708-01 11/23/82	708-01 09/07/86	708-01 02/25/87	708-01 01/11/88	
PARAMETER	UNIT OF MEASURE	PARAMETER VALUE+/-UNCERTAINTY	PARAMETER VALUE+/-UNCERTAINTY	PARAMETER VALUE+/-UNCERTAINTY	PARAMETER VALUE+/-UNCERTAINTY	PARAMETER VALUE+/-UNCERTAINTY	
ALKALINITY	MG/L CACO3	272.00	261.00	283.	263.	206.	
ALUMINUM	MG/L	0.01	0.037	0.2	< 0.1	0.35	
AMMONIUM	MG/L	-	-	< 0.1	8.2	< 0.1	
ANTIMONY	MG/L	-	-	< 0.003	-	-	
ARSENIC	MG/L	< 0.01	0.007	< 0.01	-	0.01	
BALANCE	%	-	-	0.01	-	-	
BARIUM	MG/L	0.021	-	< 0.1	-	-	
BICARBONATE	MG/L	332.00	318.00	-	-	-	
BORON	MG/L	-	-	0.5	0.23	0.36	
CADMIUM	MG/L	< 0.01	-	< 0.001	-	-	
CALCIUM	MG/L	440.00	319.00	512.	383.	405.	
CHLORIDE	MG/L	343.00	592.00	150.	358.	320.	
CHROMIUM	MG/L	< 0.01	-	0.03	0.04	0.01	
COBALT	MG/L	-	-	0.09	-	-	
CONDUCTANCE	UMHO/CM	10400.00	9670.00	6750.	4650.	6700.	
COPPER	MG/L	0.033	-	0.03	-	-	
FLUORIDE	MG/L	< 1.00	< 1.00	0.7	0.50	0.5	
GROSS ALPHA	PCI/L	-	-	-	-	31.	37.
GROSS BETA	PCI/L	-	-	-	-	17.	27.
IRON	MG/L	< 0.05	-	0.06	0.05	0.2	
LEAD	MG/L	< 0.01	-	< 0.01	-	-	
MAGNESIUM	MG/L	325.00	319.00	320.	313.	190.	
MANGANESE	MG/L	-	-	0.03	0.03	0.02	
MERCURY	MG/L	< 0.002	-	< 0.0002	-	-	
MOLYBDENUM	MG/L	< 0.05	< 0.05	0.11	< 0.1	0.13	
NICKEL	MG/L	-	-	0.06	-	-	
NITRATE	MG/L	2.00	< 5.00	9.	1.6	1.3	
NITRITE	MG/L	-	-	< 0.1	-	-	
ORG. CARBON	MG/L	-	-	-	-	55.9	
PH	SU	6.97	6.97	7.28	7.61	7.1	
PHOSPHATE	MG/L	-	-	< 0.1	-	-	
POTASSIUM	MG/L	21.00	18.00	22.1	16.6	12.9	
RA-226	PCI/L	< 2.00	< 2.00	-	-	0.1	0.1
RA-228	PCI/L	< 2.00	-	-	-	0.0	0.8
SELENIUM	MG/L	0.013	0.014	< 0.005	0.40	0.284	
SILCON	MG/L	6.70	-	-	-	-	
SILICA	MG/L	-	-	7.	-	-	
SILVER	MG/L	< 0.01	-	< 0.01	-	-	
SODIUM	MG/L	2225.00	2400.00	1980.	2320.	1760.	
STRONTIUM	MG/L	-	-	0.8	-	-	
SULFATE	MG/L	5409.00	5684.00	6180.	6280.	4800.	
TEMPERATURE	C - DEGREE	21.00	13.00	20.	10.0	8.	
TH-230	PCI/L	< 0.10	-	-	-	-	
TIN	MG/L	-	-	< 0.005	-	-	
TOTAL SO[illegible]	MG/L	8940.00	9190.00	9340.	10400.	7800.	
URANIUM	MG/L	0.027	0.034	0.0080	0.0077	0.0175	

Table D.5.15 Chemical analyses of groundwater, Green River, Utah, tailings site (Continued)

FORMATION OF COMPLETION: ALLUVIUM
HYDRAULIC FLOW RELATIONSHIP: CROSS GRADIENT

		LOCATION ID - SAMPLE ID AND LOG DATE				
		708-01 09/15/82	708-01 11/23/82	708-01 09/07/86	708-01 02/25/87	708-01 01/11/88
PARAMETER	UNIT OF MEASURE	PARAMETER VALUE+/-UNCERTAINTY	PARAMETER VALUE+/-UNCERTAINTY	PARAMETER VALUE+/-UNCERTAINTY	PARAMETER VALUE+/-UNCERTAINTY	PARAMETER VALUE+/-UNCERTAINTY
VANADIUM	MG/L	< 0.05	< 0.05	0.22	-	0.06
ZINC	MG/L	-	-	0.024	-	0.016

Table D.5.15 Chemical analyses of groundwater, Green River, Utah, tailings site (Continued)

FORMATION OF COMPLETION: SHALE
HYDRAULIC FLOW RELATIONSHIP: UP GRADIENT

PARAMETER	UNIT OF MEASURE	806-01 10/23/87 PARAMETER VALUE	+/-UNCERTAINTY	806-01 01/10/88 PARAMETER VALUE	+/-UNCERTAINTY	806-01 07/21/88 PARAMETER VALUE	+/-UNCERTAINTY	807-01 10/06/87 PARAMETER VALUE	+/-UNCERTAINTY	807-01 01/07/88 PARAMETER VALUE	+/-UNCERTAINTY
ALKALINITY	MG/L CACO3	988.		967.		986.		627.		643.	
ALUMINUM	MG/L	< 0.1		< 0.1		< 0.01		< 0.1		0.1	
AMMONIUM	MG/L	0.2		0.1		< 0.1		0.4		0.1	
ARSENIC	MG/L	< 0.01		< 0.01		0.007		< 0.01		0.021	
BARIUM	MG/L	-		-		0.01		-		-	
BORON	MG/L	0.8		0.89		0.8		0.8		0.84	
CADMIUM	MG/L	-		-		0.026		-		-	
CALCIUM	MG/L	4.9		5.20		4.73		83.		137.	
CHLORIDE	MG/L	188.		160.		200.		100.		100.	
CHROMIUM	MG/L	< 0.01		0.02		< 0.01		< 0.01		0.02	
CONDUCTANCE	UMHO/CM	2750.		2870.		2800.		8000.		8880.	
COPPER	MG/L	-		-		< 0.01		-		-	
FLUORIDE	MG/L	1.8		1.95		3.5		1.9		1.24	
GROSS ALPHA	PCI/L	0.0	23.	5.	13.	0.	19.	0.0	36.	31.	32.
GROSS BETA	PCI/L	4.5	18.	2.3	9.6	5.	11.	0.0	38.	49.	35.
IRON	MG/L	< 0.03		0.12		< 0.01		< 0.03		0.14	
LEAD	MG/L	-		-		0.01		-		-	
MAGNESIUM	MG/L	1.54		1.54		1.37		45.		54.7	
MANGANESE	MG/L	< 0.01		0.01		< 0.01		0.04		0.05	
MERCURY	MG/L	-		-		< 0.0002		-		-	
MOLYBDENUM	MG/L	< 0.01		0.02		0.02		0.07		0.11	
NITRATE	MG/L	< 1.0		< 0.1		0.3		670.		975.	
ORG. CARBON	MG/L	4.		233.		182.		19.		176.	
PH	SU	7.9		8.0		8.07		7.65		7.4	
POTASSIUM	MG/L	1.42		1.57		1.6		4.4		5.5	
RA-226	PCI/L	0.1	0.1	0.3	0.2	0.0	0.1	1.5	0.4	0.	0.1
RA-228	PCI/L	0.3	0.9	0.	0.9	0.1	0.8	1.1	0.8	0.4	0.9
SELENIUM	MG/L	< 0.005		0.048		0.022		0.17		0.25	
SILVER	MG/L	-		-		< 0.01		-		-	
SODIUM	MG/L	850.		871.		823.		2260.		2450.	
SULFATE	MG/L	570.		770.		682.		4000.		4160.	
SULFIDE	MG/L	-		-		< 0.1		-		-	
TEMPERATURE	C - DEGREE	16.0		14.8		17.0		17.5		14.3	
TOTAL SOLIDS	MG/L	2200.		2400.		2290.		7550.		9540.	
URANIUM	MG/L	< 0.003		< 0.0003		< 0.0003		0.005		0.0053	
VANADIUM	MG/L	< 0.01		< 0.01		< 0.01		< 0.01		0.02	
ZINC	MG/L	< 0.005		0.049		< 0.005		< 0.005		0.013	

Table D.5.15 Chemical analyses of groundw , Green River, Utah, tailings site (Continued)

FORMATION OF COMPLETION: SHALE
HYDRAULIC FLOW RELATIONSHIP: UP GRADIENT

		LOCATION ID - SAMPLE ID AND LOG DATE							
		807-01 07/21/88		816-01 10/23/87		816-01 01/07/88			
PARAMETER	UNIT OF MEASURE	PARAMETER VALUE+/-UNCERTAINTY		PARAMETER VALUE+/-UNCERTAINTY		PARAMETER VALUE+/-UNCERTAINTY		PARAMETER VALUE+/-UNCERTAINTY	PARAMETER VALUE+/-UNCERTAINTY
ALKALINITY	MG/L CACO3	616.		-		485.			
ALUMINUM	MG/L	0.07		0.9		0.4			
AMMONIUM	MG/L	< 0.1		1.4		< 0.1			
ARSENIC	MG/L	0.013		< 0.01		0.014			
BARIUM	MG/L	0.01		-		-			
BORON	MG/L	0.84		0.6		0.52			
CADMIUM	MG/L	0.125		-		-			
CALCIUM	MG/L	175.		410.		436.			
CHLORIDE	MG/L	130.		165.		340.			
CHROMIUM	MG/L	0.06		< 0.01		0.05			
CONDUCTANCE	UMHO/CM	10500.		3700.		5210.			
COPPER	MG/L	< 0.01		-		-			
FLUORIDE	MG/L	1.3		0.8		0.52			
GROSS ALPHA	PCI/L	0.	67.	-		21.	25.		
GROSS BETA	PCI/L	0.	38.	-		40.	27.		
IRON	MG/L	0.04		0.43		0.4			
LEAD	MG/L	0.02		-		-			
MAGNESIUM	MG/L	63.3		300.		542.			
MANGANESE	MG/L	0.07		0.21		0.1			
MERCURY	MG/L	< 0.0002		-		-			
MOLYBDENUM	MG/L	0.07		0.02		0.05			
NITRATE	MG/L	1280.		85.		93.			
ORG. CARBON	MG/L	158.		-		81.7			
PH	SU	7.45		7.6		7.2			
POTASSIUM	MG/L	7.2		22.4		29.5			
RA-226	PCI/L	0.0	0.1	-		0.1	0.1		
RA-228	PCI/L	0.8	0.7	-		0.7	0.8		
SELENIUM	MG/L	0.322		0.72		2.5			
SILVER	MG/L	< 0.01		-		-			
SODIUM	MG/L	3240.		790.		707.			
SULFATE	MG/L	6450.		3600.		3940.			
SULFIDE	MG/L	< 0.1		-		-			
TEMPERATURE	C - DEGREE	17.5		15.0		13.3			
TOTAL SOLIDS	MG/L	11700.		6220.		7300.			
URANIUM	MG/L	0.0054		0.038		0.0074			
VANADIUM	MG/L	0.03		< 0.01		0.08			
ZINC	MG/L	0.007		0.046		0.068			

MAPPER DATA FILE NAME: GRN01*UDPGW0102191

Table D.5.15 Chemical analyses of groundwater, Green River, Utah, tailings site (Continued)

FORMATION OF COMPLETION: SHALE
HYDRAULIC FLOW RELATIONSHIP: ON-SITE

PARAMETER	UNIT OF MEASURE	701-01 07/14/82 PARAMETER VALUE+/-UNCERTAINTY	701-01 06/06/86 PARAMETER VALUE+/-UNCERTAINTY	701-02 06/06/86 PARAMETER VALUE+/-UNCERTAINTY	701-03 06/06/86 PARAMETER VALUE+/-UNCERTAINTY	701-04 06/06/86 PARAMETER VALUE+/-UNCERTAINTY
ALKALINITY	MG/L CACO3	330.00	442.	442.	442.	442.
ALUMINUM	MG/L	< 0.10	-	-	-	-
AMMONIUM	MG/L	-	34.	30.	30.	30.
ANTIMONY	MG/L	-	-	-	-	-
ARSENIC	MG/L	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
BALANCE	%	-	-1.10	-0.02	-0.02	-0.02
BARIUM	MG/L	-	-	-	-	-
BICARBONATE	MG/L	403.00	-	-	-	-
BORON	MG/L	-	-	-	-	-
CADMIUM	MG/L	-	-	-	-	-
CALCIUM	MG/L	390.00	511.	510.	510.	510.
CHLORIDE	MG/L	100.00	107.	110.	110.	110.
CHROMIUM	MG/L	-	-	-	-	-
COBALT	MG/L	-	-	-	-	-
CONDUCTANCE	UMHO/CM	7410.00	5000.	5000.	5000.	5000.
COPPER	MG/L	-	-	-	-	-
FLUORIDE	MG/L	2.00	0.9	0.9	0.9	0.9
GROSS ALPHA	PCI/L	-	-	-	-	-
GROSS BETA	PCI/L	-	-	-	-	-
IRON	MG/L	< 0.05	0.08	0.08	0.08	0.08
LEAD	MG/L	-	-	-	-	-
MAGNESIUM	MG/L	140.00	190.	190.	190.	190.
MANGANESE	MG/L	-	2.2	2.3	2.3	2.3
MERCURY	MG/L	-	-	-	-	-
MOLYBDENUM	MG/L	< 0.05	0.2	0.18	0.2	0.2
NICKEL	MG/L	-	-	-	-	-
NITRATE	MG/L	28.00	1370.	1190.	1190.	1190.
NITRITE	MG/L	-	-	-	-	-
ORG. CARBON	MG/L	-	-	-	-	-
PB-210	PCI/L	-	-	-	-	-
PH	SU	7.00	7.67	7.67	7.67	7.67
PHOSPHATE	MG/L	-	-	-	-	-
PO-210	PCI/L	-	-	-	-	-
POTASSIUM	MG/L	11.00	13.5	13.3	13.3	13.3
RA-226	PCI/L	< 2.00	0.3 0.2	-	-	-
RA-228	PCI/L	-	0.6 0.9	-	-	-
SELENIUM	MG/L	0.36	0.01	0.01	0.01	0.01
SILICA	MG/L	-	-	-	-	-
SILVER	MG/L	-	-	-	-	-
SODIUM	MG/L	1530.00	1190.	1170.	1170.	1170.
STRONTIUM	MG/L	-	-	-	-	-
SULFATE	MG/L	3610.00	3040.	3020.	3020.	3020.
SULFIDE	MG/L	-	-	-	-	-
TEMPERATURE	C - DEGREE	18.00	17.	17.	17.	1[illegible]
TH-230	PCI/L	-	-	-	-	-
TIN	MG/L	-	-	-	-	-

Table D.5.15 Chemical analyses of groundwater, Green River, Utah, tailings site (Continued)

FORMATION OF COMPLETION: SHALE
HYDRAULIC FLOW RELATIONSHIP: ON-SITE

		LOCATION ID - SAMPLE ID AND LOG DATE				
		701-01 07/14/82	701-01 06/06/86	701-02 06/06/86	701-03 06/06/86	701-04 06/06/86
PARAMETER	UNIT OF MEASURE	PARAMETER VALUE+/-UNCERTAINTY	PARAMETER VALUE+/-UNCERTAINTY	PARAMETER VALUE+/-UNCERTAINTY	PARAMETER VALUE+/-UNCERTAINTY	PARAMETER VALUE+/-UNCERTAINTY
TOTAL SOLIDS	MG/L	6010.00	7110.	7160.	7100.	7120.
URANIUM	MG/L	1.40	3.11	2.94	2.99	2.98
VANADIUM	MG/L	< 0.05	-	-	-	-
ZINC	MG/L	-	-	-	-	-

Table D.5.15 Chemical analyses of groundwater, Green River, Utah, tailings site (Continued)

FORMATION OF COMPLETION: SHALE
HYDRAULIC FLOW RELATIONSHIP: ON-SITE

		LOCATION ID - SAMPLE ID AND LOG DATE									
		701-05 06/06/86		701-01 09/07/86		701-01 03/13/87		701-01 10/06/87		701-01 01/12/88	
PARAMETER	UNIT OF MEASURE	PARAMETER VALUE+/-UNCERTAINTY		PARAMETER VALUE+/-UNCERTAINTY		PARAMETER VALUE+/-UNCERTAINTY		PARAMETER VALUE+/-UNCERTAINTY		PARAMETER VALUE+/-UNCERTAINTY	
ALKALINITY	MG/L CACO3	442.		395.		407.		398.		253.	
ALUMINUM	MG/L	-		0.3		0.2		< 0.1		0.4	
AMMONIUM	MG/L	30.		30.		32.		47.		47.7	
ANTIMONY	MG/L	-		< 0.003		-		-		-	
ARSENIC	MG/L	< 0.01		< 0.01		-		< 0.01		< 0.01	
BALANCE	%	-0.02		0.09		-		-		-	
BARIUM	MG/L	-		0.1		-		-		-	
BICARBONATE	MG/L	-		-		-		-		-	
BORON	MG/L	-		0.6		0.6		0.6		0.69	
CADMIUM	MG/L	-		< 0.001		-		-		-	
CALCIUM	MG/L	510.		337.		366.		380.		407.	
CHLORIDE	MG/L	110.		100.		86.		96.		96.	
CHROMIUM	MG/L	-		0.05		0.03		< 0.01		0.02	
COBALT	MG/L	-		0.09		-		-		-	
CONDUCTANCE	UMHO/CM	5000.		500.		4100.		6200.		5450.	
COPPER	MG/L	-		0.03		-		-		-	
FLUORIDE	MG/L	0.9		1.0		1.0		1.0		0.92	
GROSS ALPHA	PCI/L	-		-		-		970.	120.	1100.	100.
GROSS BETA	PCI/L	-		-		-		270.	56.	620.	40.
IRON	MG/L	0.08		0.05		0.12		< 0.03		0.25	
LEAD	MG/L	-		< 0.01		-		-		-	
MAGNESIUM	MG/L	190.		139.		160.		180.		176.	
MANGANESE	MG/L	2.3		1.23		1.60		1.65		1.81	
MERCURY	MG/L	-		< 0.0002		-		-		-	
MOLYBDENUM	MG/L	0.2		0.13		< 0.1		0.01		0.14	
NICKEL	MG/L	-		0.06		-		-		-	
NITRATE	MG/L	1190.		570.		2480.		1120.		1020.	
NITRITE	MG/L	-		< 0.1		-		-		-	
ORG. CARBON	MG/L	-		96.		-		41.		110.	
PB-210	PCI/L	-		13.	2.	-		-		-	
PH	SU	7.67		7.60		7.18		6.85		6.88	
PHOSPHATE	MG/L	-		< 0.1		-		-		-	
PO-210	PCI/L	-		1.4	0.8	-		-		-	
POTASSIUM	MG/L	13.3		12.2		10.8		9.6		10.4	
RA-226	PCI/L	-		0.8	0.3	-		0.8	0.3	0.1	0.1
RA-228	PCI/L	-		0.9	1.0	-		1.0	0.8	0.8	0.7
SELENIUM	MG/L	0.01		0.121		0.150		0.37		0.546	
SILICA	MG/L	-		8.		-		-		-	
SILVER	MG/L	-		< 0.01		-		-		-	
SODIUM	MG/L	1170.		1100.		1900.		1300.		1190.	
STRONTIUM	MG/L	-		7.0		-		-		-	
SULFATE	MG/L	3020.		3420.		3170.		3100.		3000.	
SULFIDE	MG/L	-		-		-		-		-	
TEMPERATURE	C - DEGREE	17.		17.0		16.		16.0		1[illegible]	
TH-230	PCI/L	-		1.7		-		-		-	
TIN	MG/L	-		< 0.005		-		-		-	

Table D.5.15 Chemical analyses of groundw   , Green River, Utah, tailings site (Continued)

FORMATION OF COMPLETION: SHALE
HYDRAULIC FLOW RELATIONSHIP: ON-SITE

		LOCATION ID - SAMPLE ID AND LOG DATE				
		701-05 06/06/86	701-01 09/07/86	701-01 03/13/87	701-01 10/06/87	701-01 01/12/88
PARAMETER	UNIT OF MEASURE	PARAMETER VALUE+/-UNCERTAINTY	PARAMETER VALUE+/-UNCERTAINTY	PARAMETER VALUE+/-UNCERTAINTY	PARAMETER VALUE+/-UNCERTAINTY	PARAMETER VALUE+/-UNCERTAINTY
TOTAL SOLIDS	MG/L	7120.	6550.	7070.	6460.	6130.
URANIUM	MG/L	3.05	1.86	1.59	1.71	2.23
VANADIUM	MG/L	-	0.18	-	< 0.01	0.07
ZINC	MG/L	-	0.017	-	0.038	0.011

Table D.5.15 Chemical analyses of groundwater, Green River, Utah, tailings site (Continued)

FORMATION OF COMPLETION: SHALE
HYDRAULIC FLOW RELATIONSHIP: ON-SITE

		LOCATION ID - SAMPLE ID AND LOG DATE				
		701-01 05/11/88				
PARAMETER	UNIT OF MEASURE	PARAMETER VALUE+/-UNCERTAINTY	PARAMETER VALUE+/-UNCERTAINTY	PARAMETER VALUE+/-UNCERTAINTY	PARAMETER VALUE+/-UNCERTAINTY	PARAMETER VALUE+/-UNCERTAINTY
ALKALINITY	MG/L CACO3	407.				
ALUMINUM	MG/L	0.23				
AMMONIUM	MG/L	51.				
ANTIMONY	MG/L	-				
ARSENIC	MG/L	0.015				
BALANCE	%	-				
BARIUM	MG/L	0.01				
BICARBONATE	MG/L	-				
BORON	MG/L	0.71				
CADMIUM	MG/L	0.003				
CALCIUM	MG/L	520.				
CHLORIDE	MG/L	94.				
CHROMIUM	MG/L	0.15				
COBALT	MG/L	0.03				
CONDUCTANCE	UMHO/CM	5410.				
COPPER	MG/L	0.02				
FLUORIDE	MG/L	0.77				
GROSS ALPHA	PCI/L	-				
GROSS BETA	PCI/L	-				
IRON	MG/L	0.16				
LEAD	MG/L	0.02				
MAGNESIUM	MG/L	197.				
MANGANESE	MG/L	2.18				
MERCURY	MG/L	0.0012				
MOLYBDENUM	MG/L	0.09				
NICKEL	MG/L	0.01				
NITRATE	MG/L	1730.				
NITRITE	MG/L	-				
ORG. CARBON	MG/L	-				
PB-210	PCI/L	-				
PH	SU	6.68				
PHOSPHATE	MG/L	0.3				
PO-210	PCI/L	-				
POTASSIUM	MG/L	20.5				
RA-226	PCI/L	-				
RA-228	PCI/L	-				
SELENIUM	MG/L	0.549				
SILICA	MG/L	18.0				
SILVER	MG/L	-				
SODIUM	MG/L	1150.				
STRONTIUM	MG/L	7.87				
SULFATE	MG/L	2870.				
SULFIDE	MG/L	< 0.1				
TEMPERAT	C - DEGREE	16.5				
TH-230	PCI/L	-				
TIN	MG/L	-				

Table D.5.15 Chemical analyses of ground[illegible]er, Green River, Utah, tailings site (Continued)

FORMATION OF COMPLETION: SHALE
HYDRAULIC FLOW RELATIONSHIP: ON-SITE

		LOCATION ID - SAMPLE ID AND LOG DATE				
		701-01 05/11/88				
PARAMETER	UNIT OF MEASURE	PARAMETER VALUE+/-UNCERTAINTY				
TOTAL SOLIDS	MG/L	6680.				
URANIUM	MG/L	2.99				
VANADIUM	MG/L	0.08				
ZINC	MG/L	0.018				

MAPPER DATA FILE NAME: GRN01*UDPGW0102190

Table D.5.15 Chemical analyses of groundwater, Green River, Utah, tailings site (Continued)

FORMATION OF COMPLETION: SHALE
HYDRAULIC FLOW RELATIONSHIP: DOWN GRADIENT

		LOCATION ID - SAMPLE ID AND LOG DATE									
		583-01 09/12/86		583-01 03/13/87		583-01 10/02/87		583-01 01/11/88		583-01 07/21/88	
PARAMETER	UNIT OF MEASURE	PARAMETER VALUE+/-UNCERTAINTY		PARAMETER VALUE+/-UNCERTAINTY		PARAMETER VALUE+/-UNCERTAINTY		PARAMETER VALUE+/-UNCERTAINTY		PARAMETER VALUE+/-UNCERTAINTY	
ALKALINITY	MG/L CACO3	193.		670.		1030.		1220.		1563.	
ALUMINUM	MG/L	0.3		< 0.1		< 0.1		0.2		0.06	
AMMONIUM	MG/L	1.1		0.4		0.5		0.3		0.4	
ANTIMONY	MG/L	< 0.003		-		-		-		-	
ARSENIC	MG/L	< 0.01		-		< 0.01		< 0.01		0.015	
BALANCE	%	0.11		-		-		-		-	
BARIUM	MG/L	0.2		-		-		-		0.01	
BORON	MG/L	0.4		1.0		1.2		1.23		1.2	
CADMIUM	MG/L	< 0.001		-		-		-		0.048	
CALCIUM	MG/L	303.		327.		230.		218.		186.	
CHLORIDE	MG/L	740.		925.		830.		900.		1120.	
CHROMIUM	MG/L	0.02		0.02		< 0.01		0.03		0.07	
COBALT	MG/L	< 0.05		-		-		-		-	
CONDUCTANCE	UMHO/CM	4500.		7000.		7000.		6270.		6750.	
COPPER	MG/L	0.03		-		-		-		< 0.01	
FLUORIDE	MG/L	1.2		0.4		0.2		0.36		0.4	
GROSS ALPHA	PCI/L	-		-		0.8	61.	4.	27.	0.	54.
GROSS BETA	PCI/L	-		-		0.0	38.	0.	19.	15.	29.
IRON	MG/L	< 0.03		0.03		0.16		0.56		0.22	
LEAD	MG/L	< 0.01		-		-		-		0.02	
MAGNESIUM	MG/L	127.		136.		112.		87.7		76.2	
MANGANESE	MG/L	0.07		0.09		0.02		0.07		0.06	
MERCURY	MG/L	< 0.0002		-		-		-		< 0.0002	
MOLYBDENUM	MG/L	0.10		< 0.1		< 0.01		0.09		0.05	
NICKEL	MG/L	0.05		-		-		-		-	
NITRATE	MG/L	14.		71.		40.		48.3		4.4	
NITRITE	MG/L	< 0.1		-		-		-		-	
ORG. CARBON	MG/L	120.		-		2.		279.		404.	
PB-210	PCI/L	0.0	1.4	-		-		-		-	
PH	SU	8.10		6.79		6.60		6.7		7.10	
PHOSPHATE	MG/L	< 0.1		-		-		-		-	
PO-210	PCI/L	0.0	0.6	-		-		-		-	
POTASSIUM	MG/L	10.3		10.7		6.6		6.68		6.8	
RA-226	PCI/L	0.7	0.3	-		1.1	0.3	0.7	0.2	1.0	0.3
RA-228	PCI/L	0.1	1.2	-		2.6	1.2	2.	1.	1.4	0.9
SELENIUM	MG/L	0.111		0.009		0.019		0.104		0.062	
SILICA	MG/L	3.		-		-		-		-	
SILVER	MG/L	< 0.01		-		-		-		< 0.01	
SODIUM	MG/L	1220.		1520.		1690.		1870.		1860.	
STRONTIUM	MG/L	6.5		-		-		-		-	
SULFATE	MG/L	2630.		2580.		2340.		2290.		1440.	
SULFIDE	MG/L	-		-		-		-		< 0.1	
TEMPERATURE	C - DEGREE	17.5		14.		16.0		13.0		[illegible]	
TH-230	PCI/L	0.7	0.6	-		-		-			
TIN	MG/L	< 0.005		-		-		-			
TOTAL S[illegible]S	MG/L	5360.		6100.		5840.		6200.		6190.	

Table D.5.15 Chemical analyses of ground r, Green River, Utah, tailings site (Continued)

FORMATION OF COMPLETION: SHALE
HYDRAULIC FLOW RELATIONSHIP: DOWN GRADIENT

		LOCATION ID - SAMPLE ID AND LOG DATE				
		583-01 09/12/86	583-01 03/13/87	583-01 10/02/87	583-01 01/11/88	583-01 07/21/88
PARAMETER	UNIT OF MEASURE	PARAMETER VALUE+/-UNCERTAINTY	PARAMETER VALUE+/-UNCERTAINTY	PARAMETER VALUE+/-UNCERTAINTY	PARAMETER VALUE+/-UNCERTAINTY	PARAMETER VALUE+/-UNCERTAINTY
URANIUM	MG/L	0.0042	0.0139	0.014	0.0105	0.0036
VANADIUM	MG/L	0.23	-	< 0.01	0.03	0.03
ZINC	MG/L	0.054	-	0.005	0.013	0.007

Table D.5.15 Chemical analyses of groundwater, Green River, Utah, tailings site (Continued)

FORMATION OF COMPLETION: SHALE
HYDRAULIC FLOW RELATIONSHIP: DOWN GRADIENT

		LOCATION ID - SAMPLE ID AND LOG DATE									
		584-01 09/11/86		584-01 03/13/87		584-01 10/06/87		584-01 01/12/88		584-01 05/11/88	
PARAMETER	UNIT OF MEASURE	PARAMETER VALUE+/-UNCERTAINTY		PARAMETER VALUE+/-UNCERTAINTY		PARAMETER VALUE+/-UNCERTAINTY		PARAMETER VALUE+/-UNCERTAINTY		PARAMETER VALUE+/-UNCERTAINTY	
ALKALINITY	MG/L CACO3	286.		267.		252.		263.		266.	
ALUMINUM	MG/L	0.2		0.2		< 0.1		0.17		0.06	
AMMONIUM	MG/L	1.0		0.9		0.7		0.5		0.7	
ANTIMONY	MG/L	< 0.003		-		-		-		-	
ARSENIC	MG/L	< 0.01		-		< 0.01		0.01		0.008	
BALANCE	%	-0.38		-		-		-		-	
BARIUM	MG/L	0.2		-		-		-		0.01	
BORON	MG/L	0.3		0.3		0.6		0.67		0.65	
CADMIUM	MG/L	< 0.001		-		-		-		0.003	
CALCIUM	MG/L	57.5		39.7		47.		39.4		46.7	
CHLORIDE	MG/L	530.		95.4		120.		110.		130.	
CHROMIUM	MG/L	0.02		0.02		< 0.01		0.02		0.02	
COBALT	MG/L	< 0.05		-		-		-		0.01	
CONDUCTANCE	UMHO/CM	4800.		4250.		4620.		5100.		5100.	
COPPER	MG/L	< 0.02		-		-		-		< 0.01	
FLUORIDE	MG/L	1.9		1.9		1.9		1.76		1.73	
GROSS ALPHA	PCI/L	-		-		0.0	40.	15.	19.	-	
GROSS BETA	PCI/L	-		-		0.0	29.	6.	13.	-	
IRON	MG/L	< 0.03		0.11		0.08		0.22		0.06	
LEAD	MG/L	0.03		-		-		-		0.03	
MAGNESIUM	MG/L	15.2		12.8		14.7		12.9		13.4	
MANGANESE	MG/L	0.02		0.05		0.02		0.03		0.03	
MERCURY	MG/L	< 0.0002		-		-		-		< 0.0002	
MOLYBDENUM	MG/L	0.10		< 0.1		< 0.01		< 0.01		0.01	
NICKEL	MG/L	0.04		-		-		-		0.02	
NITRATE	MG/L	5.		0.4		5.8		< 0.1		1.0	
NITRITE	MG/L	< 0.1		-		-		-		-	
ORG. CARBON	MG/L	62.		-		4.		30.		-	
PB-210	PCI/L	1.5	1.3	-		-		-		-	
PH	SU	9.08		8.41		7.95		8.0		7.96	
PHOSPHATE	MG/L	< 0.1		-		-		-		0.3	
PO-210	PCI/L	0.0	0.5	-		-		-		-	
POTASSIUM	MG/L	4.78		2.60		2.7		2.91		3.27	
RA-226	PCI/L	0.2	0.2	-		0.8	0.3	0.1	0.1	-	
RA-228	PCI/L	0.0	1.0	-		2.8	1.2	0.2	0.7	-	
SELENIUM	MG/L	0.093		< 0.002		< 0.005		0.249		0.112	
SILICA	MG/L	5.		-		-		-		9.2	
SILVER	MG/L	< 0.01		-		-		-		-	
SODIUM	MG/L	1880.		1610.		1490.		1580.		1630.	
STRONTIUM	MG/L	3.1		-		-		-		3.50	
SULFATE	MG/L	3460.		3150.		3100.		2560.		3160.	
SULFIDE	MG/L	-		-		-		-		< 0.1	
TEMPERATURE	C - DEGREE	17.0		15.0		14.8		14.0		15[illegible]	
TH-230	PCI/L	0.6	0.6	-		-		-		-	
TIN	MG/L	< 0.005		-		-		-		-	
TOTAL SOL[illegible]	MG/L	4890.		5130.		5040.		4930.		4930.	

Table D.5.15 Chemical analyses of ground[illegible]er, Green River, Utah, tailings site (Continued)

FORMATION OF COMPLETION: SHALE
HYDRAULIC FLOW RELATIONSHIP: DOWN GRADIENT

		LOCATION ID - SAMPLE ID AND LOG DATE				
		584-01 09/11/86	584-01 03/13/87	584-01 10/06/87	584-01 01/12/88	584-01 05/11/88
PARAMETER	UNIT OF MEASURE	PARAMETER VALUE+/-UNCERTAINTY	PARAMETER VALUE+/-UNCERTAINTY	PARAMETER VALUE+/-UNCERTAINTY	PARAMETER VALUE+/-UNCERTAINTY	PARAMETER VALUE+/-UNCERTAINTY
URANIUM	MG/L	< 0.0003	< 0.0003	0.003	0.0009	0.0007
VANADIUM	MG/L	0.27	-	< 0.01	0.02	0.01
ZINC	MG/L	0.013	-	0.024	0.007	< 0.005

Table D.5.15 Chemical analyses of groundwater, Green River, Utah, tailings site (Continued)

FORMATION OF COMPLETION: SHALE
HYDRAULIC FLOW RELATIONSHIP: DOWN GRADIENT

		LOCATION ID - SAMPLE ID AND LOG DATE									
		584-01 07/16/88		585-01 09/12/86		585-01 03/13/87		585-01 10/02/87		585-01 01/10/88	
PARAMETER	UNIT OF MEASURE	PARAMETER VALUE+/-UNCERTAINTY		PARAMETER VALUE+/-UNCERTAINTY		PARAMETER VALUE+/-UNCERTAINTY		PARAMETER VALUE+/-UNCERTAINTY		PARAMETER VALUE+/-UNCERTAINTY	
ALKALINITY	MG/L CACO3	259.		1007.		938.		848.		766.	
ALUMINUM	MG/L	0.02		0.3		0.3		0.1		< 0.1	
AMMONIUM	MG/L	0.2		1.0		2.0		1.3		0.7	
ANTIMONY	MG/L	-		< 0.003		-		-		-	
ARSENIC	MG/L	0.010		< 0.01		-		< 0.01		< 0.01	
BALANCE	%	-		-0.33		-		-		-	
BARIUM	MG/L	< 0.01		0.1		-		-		-	
BORON	MG/L	0.64		1.5		0.8		1.1		1.1	
CADMIUM	MG/L	0.004		< 0.001		-		-		-	
CALCIUM	MG/L	46.3		78.6		25.8		40.		36.8	
CHLORIDE	MG/L	130.		1200.		837.		750.		740.	
CHROMIUM	MG/L	0.02		0.02		0.03		< 0.01		0.07	
COBALT	MG/L	-		< 0.05		-		-		-	
CONDUCTANCE	UMHO/CM	4650.		4900.		6500.		7000.		5960.	
COPPER	MG/L	< 0.01		0.03		-		-		-	
FLUORIDE	MG/L	1.7		0.6		0.5		0.2		0.32	
GROSS ALPHA	PCI/L	0.	30.	-		-		0.0	56.	7.	38.
GROSS BETA	PCI/L	17.	17.	-		-		9.0	46.	16.	28.
IRON	MG/L	0.11		0.05		< 0.03		< 0.03		0.35	
LEAD	MG/L	0.01		< 0.01		-		-		-	
MAGNESIUM	MG/L	14.7		14.1		7.52		8.8		8.65	
MANGANESE	MG/L	0.02		0.04		< 0.01		0.01		0.03	
MERCURY	MG/L	< 0.0002		< 0.0002		-		-		-	
MOLYBDENUM	MG/L	0.01		0.09		< 0.1		< 0.01		0.02	
NICKEL	MG/L	-		0.04		-		-		-	
NITRATE	MG/L	11.		< 1.		0.4		< 1.0		< 0.1	
NITRITE	MG/L	-		< 0.1		-		-		-	
ORG. CARBON	MG/L	67.2		140.		-		5.		36.2	
PB-210	PCI/L	-		0.6	1.3	-		-		-	
PH	SU	8.09		7.30		8.52		7.10		6.9	
PHOSPHATE	MG/L	-		< 0.1		-		-		-	
PO-210	PCI/L	-		0.0	0.5	-		-		-	
POTASSIUM	MG/L	3.5		5.71		8.61		3.6		3.59	
RA-226	PCI/L	0.3	0.2	0.6	0.3	-		0.3	0.2	0.3	0.1
RA-228	PCI/L	0.7	0.8	0.6	1.0	-		1.8	1.5	0.9	0.9
SELENIUM	MG/L	0.089		0.039		< 0.002		< 0.005		0.155	
SILICA	MG/L	-		11.		-		-		-	
SILVER	MG/L	< 0.01		< 0.01		-		-		-	
SODIUM	MG/L	1460.		2240.		1940.		1900.		1920.	
STRONTIUM	MG/L	-		3.4		-		-		-	
SULFATE	MG/L	3140.		2370.		2170.		2490.		2400.	
SULFIDE	MG/L	< 0.1		-		-		-		-	
TEMPERATURE	C - DEGREE	15.0		17.5		15.0		16.0			
TH-230	PCI/L	-		0.4		-		-			
TIN	MG/L	-		< 0.005		-		-			
TOTAL S[illegible]DS	MG/L	4940.		5660.		5650.		5420.		5550.	

Table D.5.15 Chemical analyses of ground[illegible]er, Green River, Utah, tailings site (Continued)

FORMATION OF COMPLETION: SHALE
HYDRAULIC FLOW RELATIONSHIP: DOWN GRADIENT

		LOCATION ID - SAMPLE ID AND LOG DATE				
		584-01 07/16/88	585-01 09/12/86	585-01 03/13/87	585-01 10/02/87	585-01 01/10/88
PARAMETER	UNIT OF MEASURE	PARAMETER VALUE+/-UNCERTAINTY	PARAMETER VALUE+/-UNCERTAINTY	PARAMETER VALUE+/-UNCERTAINTY	PARAMETER VALUE+/-UNCERTAINTY	PARAMETER VALUE+/-UNCERTAINTY
URANIUM	MG/L	< 0.0003	< 0.0003	< 0.0003	< 0.003	< 0.0003
VANADIUM	MG/L	< 0.01	0.25	-	< 0.01	< 0.01
ZINC	MG/L	< 0.005	0.019	-	< 0.005	0.025

Table D.5.15 Chemical analyses of groundwater, Green River, Utah, tailings site (Continued)

FORMATION OF COMPLETION: SHALE
HYDRAULIC FLOW RELATIONSHIP: DOWN GRADIENT

		LOCATION ID - SAMPLE ID AND LOG DATE									
		585-01 07/18/88		585-02 07/18/88		585-03 07/18/88		585-04 07/18/88		585-05 07/18/88	
PARAMETER	UNIT OF MEASURE	PARAMETER VALUE+/-UNCERTAINTY		PARAMETER VALUE+/-UNCERTAINTY		PARAMETER VALUE+/-UNCERTAINTY		PARAMETER VALUE+/-UNCERTAINTY		PARAMETER VALUE+/-UNCERTAINTY	
ALKALINITY	MG/L CACO3	873.		873.		873.		873.		873.	
ALUMINUM	MG/L	0.02		< 0.01		0.01		< 0.01		< 0.01	
AMMONIUM	MG/L	1.2		1.2		1.2		1.2		1.2	
ANTIMONY	MG/L	-		-		-		-		-	
ARSENIC	MG/L	0.008		0.011		0.011		0.011		0.007	
BALANCE	%	-		-		-		-		-	
BARIUM	MG/L	0.01		0.01		0.01		0.01		0.01	
BORON	MG/L	1.1		1.1		1.2		1.2		1.1	
CADMIUM	MG/L	0.003		0.004		0.005		0.004		0.005	
CALCIUM	MG/L	41.9		41.3		41.3		42.5		41.9	
CHLORIDE	MG/L	830.		870.		830.		830.		840.	
CHROMIUM	MG/L	0.02		< 0.01		< 0.01		< 0.01		< 0.01	
COBALT	MG/L	-		-		-		-		-	
CONDUCTANCE	UMHO/CM	5000.		5000.		5000.		5000.		5000.	
COPPER	MG/L	< 0.01		< 0.01		< 0.01		< 0.01		< 0.01	
FLUORIDE	MG/L	0.4		0.4		0.4		0.4		0.4	
GROSS ALPHA	PCI/L	0.	49.	0.	45.	0.	48.	8.	38.	0.	47.
GROSS BETA	PCI/L	27.	26.	4.	25.	14.	26.	11.	25.	12.	26.
IRON	MG/L	0.05		0.05		0.28		0.05		0.05	
LEAD	MG/L	0.01		0.01		0.02		0.02		< 0.01	
MAGNESIUM	MG/L	9.67		9.49		9.59		9.78		9.57	
MANGANESE	MG/L	0.02		0.02		0.02		0.02		0.02	
MERCURY	MG/L	< 0.0002		< 0.0002		< 0.0002		< 0.0002		< 0.0002	
MOLYBDENUM	MG/L	< 0.01		0.02		0.01		< 0.01		0.01	
NICKEL	MG/L	-		-		-		-		-	
NITRATE	MG/L	4.1		5.6		5.7		5.6		5.4	
NITRITE	MG/L	-		-		-		-		-	
ORG. CARBON	MG/L	232.		229.		210.		223.		228.	
PB-210	PCI/L	-		-		-		-		-	
PH	SU	7.22		7.22		7.22		7.22		7.22	
PHOSPHATE	MG/L	-		-		-		-		-	
PO-210	PCI/L	-		-		-		-		-	
POTASSIUM	MG/L	4.2		4.3		4.3		4.1		4.1	
RA-226	PCI/L	0.4	0.2	0.3	0.2	0.3	0.2	0.4	0.2	0.3	0.2
RA-228	PCI/L	0.1	0.7	0.6	0.7	0.2	0.9	0.4	0.2	0.3	0.9
SELENIUM	MG/L	0.071		0.056		0.059		0.054		0.054	
SILICA	MG/L	-		-		-		-		-	
SILVER	MG/L	< 0.01		< 0.01		< 0.01		< 0.01		< 0.01	
SODIUM	MG/L	1980.		1940.		1950.		1930.		1920.	
STRONTIUM	MG/L	-		-		-		-		-	
SULFATE	MG/L	2320.		2330.		2450.		2350.		2370.	
SULFIDE	MG/L	0.2		0.1		0.2		0.1		0.2	
TEMPERATURE	C - DEGREE	16.5		16.5		16.5		16.5		16[illegible]	
TH-230	PCI/L	-		-		-		-		-	
TIN	MG/L	-		-		-		-		-	
TOTAL SOL[illegible]	MG/L	5630.		5640.		5640.		5580.		5620.	

Table D.5.15 Chemical analyses of ground[illegible]r, Green River, Utah, tailings site (Continued)

FORMATION OF COMPLETION: SHALE
HYDRAULIC FLOW RELATIONSHIP: DOWN GRADIENT

		LOCATION ID - SAMPLE ID AND LOG DATE				
		585-01 07/18/88	585-02 07/18/88	585-03 07/18/88	585-04 07/18/88	585-05 07/18/88
PARAMETER	UNIT OF MEASURE	PARAMETER VALUE+/-UNCERTAINTY	PARAMETER VALUE+/-UNCERTAINTY	PARAMETER VALUE+/-UNCERTAINTY	PARAMETER VALUE+/-UNCERTAINTY	PARAMETER VALUE+/-UNCERTAINTY
URANIUM	MG/L	< 0.0003	< 0.0003	< 0.0003	0.0003	< 0.0003
VANADIUM	MG/L	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
ZINC	MG/L	< 0.005	< 0.005	0.048	< 0.005	< 0.005

Table D.5.15 Chemical analyses of groundwater, Green River, Utah, tailings site (Continued)

FORMATION OF COMPLETION: SHALE
HYDRAULIC FLOW RELATIONSHIP: DOWN GRADIENT

		LOCATION ID - SAMPLE ID AND LOG DATE									
		809-01 10/23/87		809-01 01/07/88		810-01 10/26/87		810-01 01/07/88		810-01 07/16/88	
PARAMETER	UNIT OF MEASURE	PARAMETER VALUE	+/-UNCERTAINTY	PARAMETER VALUE	+/-UNCERTAINTY	PARAMETER VALUE	+/-UNCERTAINTY	PARAMETER VALUE	+/-UNCERTAINTY	PARAMETER VALUE	+/-UNCERTAINTY
ALKALINITY	MG/L CACO3	530.		485.		369.		423.		406.	
ALUMINUM	MG/L	< 0.1		< 0.1		< 0.1		< 0.1		0.09	
AMMONIUM	MG/L	0.6		0.7		0.3		0.1		< 0.1	
ANTIMONY	MG/L	-		-		-		-		-	
ARSENIC	MG/L	< 0.01		0.014		< 0.01		0.01		0.012	
BALANCE	%	-		-		-		-		-	
BARIUM	MG/L	-		-		-		-		0.04	
BORON	MG/L	0.5		0.64		0.6		0.59		0.71	
CADMIUM	MG/L	-		-		-		-		0.003	
CALCIUM	MG/L	33.		27.7		7.7		17.1		27.9	
CHLORIDE	MG/L	92.		100.		550.		150.		150.	
CHROMIUM	MG/L	< 0.01		0.02		< 0.01		0.07		< 0.01	
COBALT	MG/L	-		-		-		-		-	
CONDUCTANCE	UMHO/CM	5500.		5240.		4200.		4110.		5000.	
COPPER	MG/L	-		-		-		-		0.02	
FLUORIDE	MG/L	1.9		1.93		5.4		3.27		2.7	
GROSS ALPHA	PCI/L	0.0	33.	0.8	1.4	0.0	28.	10.	18.	0.	25.
GROSS BETA	PCI/L	0.0	31.	0.	1.7	0.0	23.	19.	18.	0.	15.
IRON	MG/L	< 0.03		0.13		< 0.03		0.32		0.04	
LEAD	MG/L	-		-		-		-		0.01	
MAGNESIUM	MG/L	16.		11.9		1.70		6.94		13.7	
MANGANESE	MG/L	0.01		0.09		< 0.01		0.21		0.08	
MERCURY	MG/L	-		-		-		-		< 0.0002	
MOLYBDENUM	MG/L	< 0.01		0.04		< 0.01		0.04		0.03	
NICKEL	MG/L	-		-		-		-		-	
NITRATE	MG/L	< 1.0		< 0.1		1.0		< 0.1		11.	
NITRITE	MG/L	-		-		-		-		-	
ORG. CARBON	MG/L	3.		118.		3.		99.6		101.	
PB-210	PCI/L	-		-		-		-		-	
PH	SU	8.2		8.3		8.3		8.05		8.22	
PHOSPHATE	MG/L	-		-		-		-		-	
PO-210	PCI/L	-		-		-		-		-	
POTASSIUM	MG/L	4.1		3.46		1.25		2.5		3.8	
RA-226	PCI/L	0.6	0.2	0.2	0.2	0.1	0.2	0.2	0.2	0.4	0.2
RA-228	PCI/L	0.5	1.3	0.9	0.9	1.0	1.4	1.3	0.9	0.5	0.7
SELENIUM	MG/L	< 0.005		0.124		< 0.005		0.083		0.071	
SILICA	MG/L	-		-		-		-		-	
SILVER	MG/L	-		-		-		-		< 0.01	
SODIUM	MG/L	1670.		1800.		810.		1280.		1420.	
STRONTIUM	MG/L	-		-		-		-		-	
SULFATE	MG/L	3140.		3270.		620.		2140.		2790.	
SULFIDE	MG/L	-		-		-		-		< 0.1	
TEMPERATURE	C - DEGREE	15.0		14.1		16.0		14.3			
TH-230	PCI/L	-		-		-		-			
TIN	MG/L	-		-		-		-			
TOTAL SOLIDS	MG/L	5340.		5100.		2740.		3970.		4700.	

Table D.5.15 Chemical analyses of groundwater, Green River, Utah, tailings site (Continued)

FORMATION OF COMPLETION: SHALE
HYDRAULIC FLOW RELATIONSHIP: DOWN GRADIENT

		LOCATION ID - SAMPLE ID AND LOG DATE				
		809-01 10/23/87	809-01 01/07/88	810-01 10/26/87	810-01 01/07/88	810-01 07/16/88
PARAMETER	UNIT OF MEASURE	PARAMETER VALUE+/-UNCERTAINTY	PARAMETER VALUE+/-UNCERTAINTY	PARAMETER VALUE+/-UNCERTAINTY	PARAMETER VALUE+/-UNCERTAINTY	PARAMETER VALUE+/-UNCERTAINTY
URANIUM	MG/L	< 0.003	0.0014	0.005	0.004	0.0012
VANADIUM	MG/L	< 0.01	0.01	< 0.01	< 0.01	< 0.01
ZINC	MG/L	< 0.005	0.009	< 0.005	0.127	0.013

MAPPER DATA FILE NAME: GRN01*UDPGW0102189

Table D.5.15 Chemical analyses of groundwater, Green River, Utah, tailings site (Continued)

FORMATION OF COMPLETION: CONGLOMERATE
HYDRAULIC FLOW RELATIONSHIP: UP GRADIENT

PARAMETER	UNIT OF MEASURE	LOCATION ID - SAMPLE ID AND LOG DATE: 562-01 06/05/86 PARAMETER VALUE+/-UNCERTAINTY	562-02 06/05/86 PARAMETER VALUE+/-UNCERTAINTY	562-03 06/05/86 PARAMETER VALUE+/-UNCERTAINTY	562-04 06/05/86 PARAMETER VALUE+/-UNCERTAINTY	562-05 06/05/86 PARAMETER VALUE+/-UNCERTAINTY
ALKALINITY	MG/L CACO3	600.	600.	600.	600.	600.
ALUMINUM	MG/L	0.7	0.2	0.2	0.2	0.2
AMMONIUM	MG/L	0.1	< 0.1	< 0.1	< 0.1	< 0.1
ANTIMONY	MG/L	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003
ARSENIC	MG/L	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
BALANCE	%	0.22	0.25	0.25	0.26	0.23
BARIUM	MG/L	0.1	0.2	0.2	0.2	0.2
BORON	MG/L	0.9	0.4	0.4	0.5	0.4
CADMIUM	MG/L	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
CALCIUM	MG/L	369.	368.	368.	368.	368.
CHLORIDE	MG/L	126.	127.	127.	127.	127.
CHROMIUM	MG/L	0.04	0.04	0.04	0.04	0.04
COBALT	MG/L	0.13	0.1	0.1	0.1	0.1
CONDUCTANCE	UMHO/CM	6000.	6000.	6000.	6000.	6000.
COPPER	MG/L	0.05	0.04	0.04	0.04	0.04
FLUORIDE	MG/L	1.	0.9	0.9	0.9	0.9
GROSS ALPHA	PCI/L	-	-	-	-	-
GROSS BETA	PCI/L	-	-	-	-	-
IRON	MG/L	0.06	0.08	0.08	0.08	0.08
LEAD	MG/L	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
MAGNESIUM	MG/L	150.	141.	141.	141.	141.
MANGANESE	MG/L	0.38	0.39	0.39	0.39	0.39
MERCURY	MG/L	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002
MOLYBDENUM	MG/L	0.18	0.11	0.11	0.11	0.11
NICKEL	MG/L	0.09	0.09	0.09	0.09	0.09
NITRATE	MG/L	45.	66.	66.	65.	68.
NITRITE	MG/L	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
ORG. CARBON	MG/L	-	-	-	-	-
PH	SU	7.3	7.3	7.3	7.3	7.3
PHOSPHATE	MG/L	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
POTASSIUM	MG/L	8.41	8.83	8.83	8.83	8.83
RA-226	PCI/L	-	-	-	-	-
RA-228	PCI/L	-	-	-	-	-
SELENIUM	MG/L	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005
SILICA	MG/L	4.	4.	4.	4.	4.
SILVER	MG/L	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
SODIUM	MG/L	1740.	1830.	1830.	1830.	1830.
STRONTIUM	MG/L	10.8	11.2	11.2	11.2	11.2
SULFATE	MG/L	4330.	4460.	4460.	4460.	4460.
SULFIDE	MG/L	-	-	-	-	-
TEMPERATURE	C - DEGREE	18.	18.	18.	18.	18.
TIN	MG/L	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005
TOTAL SOLIDS	MG/L	7620.	7690.	7980.	7920.	79[illegible]
URANIUM	MG/L	0.0201	0.0231	0.0254	0.0334	[illegible]35
VANADIUM	MG/L	0.1	0.12	0.11	0.1	[illegible].2
ZINC	MG/L	0.015	0.016	0.017	0.016	0.016

Table D.5.15 Chemical analyses of ground r, Green River, Utah, tailings site (Continued)

FORMATION OF COMPLETION: CONGLOMERATE
HYDRAULIC FLOW RELATIONSHIP: UP GRADIENT

		LOCATION ID - SAMPLE ID AND LOG DATE									
		562-01 09/07/86		562-01 02/27/87		562-01 10/02/87		562-01 04/05/88		562-01 05/12/88	
PARAMETER	UNIT OF MEASURE	PARAMETER VALUE	+/-UNCERTAINTY	PARAMETER VALUE	+/-UNCERTAINTY	PARAMETER VALUE	+/-UNCERTAINTY	PARAMETER VALUE	+/-UNCERTAINTY	PARAMETER VALUE	+/-UNCERTAINTY
ALKALINITY	MG/L CACO3	701.		745.		588.		635.		660.	
ALUMINUM	MG/L	0.2		< 0.1		< 0.1		0.2		0.21	
AMMONIUM	MG/L	0.3		< 0.1		< 0.1		< 0.1		0.2	
ANTIMONY	MG/L	< 0.003		-		-		-		-	
ARSENIC	MG/L	< 0.01		-		< 0.01		< 0.001		0.010	
BALANCE	%	-0.16		-		-		-		-	
BARIUM	MG/L	0.2		-		-		-		0.01	
BORON	MG/L	0.9		0.59		0.7		0.74		0.82	
CADMIUM	MG/L	< 0.001		-		-		-		0.005	
CALCIUM	MG/L	321.		298.		300.		270.		328.	
CHLORIDE	MG/L	60.		118.		129.		120.		150.	
CHROMIUM	MG/L	< 0.01		0.02		< 0.01		0.01		0.09	
COBALT	MG/L	0.06		-		-		-		0.02	
CONDUCTANCE	UMHO/CM	5200.		4575.		7900.		6700.		6240.	
COPPER	MG/L	0.03		-		-		-		0.01	
FLUORIDE	MG/L	1.0		0.73		0.9		0.81		0.85	
GROSS ALPHA	PCI/L	-		-		82.	74.	100.	40.	-	
GROSS BETA	PCI/L	-		-		0.0	40.	39.	29.	-	
IRON	MG/L	0.37		0.08		< 0.03		0.19		0.11	
LEAD	MG/L	< 0.01		-		-		-		0.02	
MAGNESIUM	MG/L	144.		150.		167.		123.		124.	
MANGANESE	MG/L	0.43		0.09		0.49		0.49		0.47	
MERCURY	MG/L	< 0.0002		-		-		-		0.0014	
MOLYBDENUM	MG/L	0.18		< 0.1		0.02		0.12		0.07	
NICKEL	MG/L	0.05		-		-		-		0.05	
NITRATE	MG/L	130.		133.		173.		62.		130.	
NITRITE	MG/L	< 0.1		-		-		-		-	
ORG. CARBON	MG/L	-		-		25.		237.		-	
PH	SU	7.03		6.93		6.9		6.9		6.88	
PHOSPHATE	MG/L	< 0.1		-		-		-		0.3	
POTASSIUM	MG/L	8.48		5.10		7.2		6.25		7.39	
RA-226	PCI/L	-		-		1.3	0.3	0.2	0.2	-	
RA-228	PCI/L	-		-		1.8	1.0	0.9	0.8	-	
SELENIUM	MG/L	< 0.005		0.32		0.020		0.164		0.160	
SILICA	MG/L	4.		-		-		-		9.7	
SILVER	MG/L	< 0.01		-		-		-		-	
SODIUM	MG/L	1900.		1910.		1750.		1570.		1870.	
STRONTIUM	MG/L	0.8		-		-		-		8.83	
SULFATE	MG/L	4480.		4510.		4600.		3550.		4330.	
SULFIDE	MG/L	-		-		-		-		< 0.1	
TEMPERATURE	C - DEGREE	18.5		16.5		16.5		15.9		16.5	
TIN	MG/L	< 0.005		-		-		-		-	
TOTAL SOLIDS	MG/L	7460.		7610.		7440.		7070.		7190.	
URANIUM	MG/L	0.0354		0.0462		0.146		0.0792		0.0402	
VANADIUM	MG/L	0.38		-		< 0.01		0.04		0.05	
ZINC	MG/L	0.020		-		0.022		0.007		0.006	

Table D.5.15 Chemical analyses of groundwater, Green River, Utah, tailings site (Continued)

FORMATION OF COMPLETION: CONGLOMERATE
HYDRAULIC FLOW RELATIONSHIP: UP GRADIENT

PARAMETER	UNIT OF MEASURE	811-01 10/22/87 PARAMETER VALUE+/-UNCERTAINTY		811-01 01/11/88 PARAMETER VALUE+/-UNCERTAINTY		811-01 07/21/88 PARAMETER VALUE+/-UNCERTAINTY		813-01 10/06/87 PARAMETER VALUE+/-UNCERTAINTY		813-01 01/07/88 PARAMETER VALUE+/-UNCERTAINTY	
ALKALINITY	MG/L CACO3	1019.		937.		993.		670.		651.	
ALUMINUM	MG/L	< 0.1		< 0.1		< 0.01		< 0.1		0.2	
AMMONIUM	MG/L	0.3		< 0.1		< 0.1		0.2		< 0.1	
ANTIMONY	MG/L	-		-		-		-		-	
ARSENIC	MG/L	< 0.01		< 0.01		0.005		0.01		0.023	
BALANCE	%	-		-		-		-		-	
BARIUM	MG/L	-		-		0.10		-		-	
BORON	MG/L	0.7		0.81		0.8		0.8		0.7	
CADMIUM	MG/L	-		-		0.025		-		-	
CALCIUM	MG/L	4.1		4.17		4.60		210.		212.	
CHLORIDE	MG/L	159.		150.		170.		116.		110.	
CHROMIUM	MG/L	< 0.01		0.07		< 0.01		< 0.01		0.01	
COBALT	MG/L	-		-		-		-		-	
CONDUCTANCE	UMHO/CM	2700.		2460.		2775.		7000.		6540.	
COPPER	MG/L	-		-		< 0.01		-		-	
FLUORIDE	MG/L	2.3		2.19		2.5		1.0		0.96	
GROSS ALPHA	PCI/L	27.	32.	4.3	9.7	36.	19.	44.	67.	150.	50.
GROSS BETA	PCI/L	39.	25.	3.5	6.7	21.	8.	31.	48.	52.	32.
IRON	MG/L	< 0.03		0.3		0.02		< 0.03		0.19	
LEAD	MG/L	-		-		< 0.01		-		-	
MAGNESIUM	MG/L	1.33		1.24		1.33		122.		111.	
MANGANESE	MG/L	0.01		0.02		0.02		0.17		0.15	
MERCURY	MG/L	-		-		< 0.0002		-		-	
MOLYBDENUM	MG/L	< 0.01		0.02		0.02		0.07		0.22	
NICKEL	MG/L	-		-		-		-		-	
NITRATE	MG/L	< 1.0		< 0.1		2.7		67.		12.	
NITRITE	MG/L	-		-		-		-		-	
ORG. CARBON	MG/L	< 1.		229.		219.		15.		227.	
PH	SU	8.0		8.1		8.05		6.90		6.9	
PHOSPHATE	MG/L	-		-		-		-		-	
POTASSIUM	MG/L	1.35		1.45		1.3		6.3		6.68	
RA-226	PCI/L	0.1	0.1	0.1	0.1	0.1	0.2	2.6	0.5	0.1	0.2
RA-228	PCI/L	2.1	1.1	0.	0.8	0.0	0.9	1.3	0.8	1.4	0.9
SELENIUM	MG/L	< 0.005		0.033		0.022		0.007		0.178	
SILICA	MG/L	-		-		-		-		-	
SILVER	MG/L	-		-		< 0.01		-		-	
SODIUM	MG/L	740.		756.		809.		1660.		1870.	
STRONTIUM	MG/L	-		-		-		-		-	
SULFATE	MG/L	450.		537.		637.		3900.		4140.	
SULFIDE	MG/L	-		-		< 0.1		-		-	
TEMPERATURE	C - DEGREE	15.5		14.3		17.5		17.0		15.7	
TIN	MG/L	-		-		-		-		-	
TOTAL SOLIDS	MG/L	2050.		2120.		2190.		6820.		67[illegible]	
URANIUM	MG/L	< 0.003		< 0.0003		0.0003		0.070		[illegible]07	
VANADIUM	MG/L	< 0.01		< 0.01		< 0.01		< 0.01		[illegible]3	
ZINC	MG/L	0.006		0.009		< 0.005		0.019		0.021	

Table D.5.15 Chemical analyses of groundw[illegible]r, Green River, Utah, tailings site (Continued)

FORMATION OF COMPLETION: CONGLOMERATE
HYDRAULIC FLOW RELATIONSHIP: UP GRADIENT

		LOCATION ID - SAMPLE ID AND LOG DATE				
		813-01 05/10/88				
PARAMETER	UNIT OF MEASURE	PARAMETER VALUE+/-UNCERTAINTY	PARAMETER VALUE+/-UNCERTAINTY	PARAMETER VALUE+/-UNCERTAINTY	PARAMETER VALUE+/-UNCERTAINTY	PARAMETER VALUE+/-UNCERTAINTY
ALKALINITY	MG/L CACO3	671.				
ALUMINUM	MG/L	0.19				
AMMONIUM	MG/L	< 0.1				
ANTIMONY	MG/L	-				
ARSENIC	MG/L	0.016				
BALANCE	%	-				
BARIUM	MG/L	0.01				
BORON	MG/L	0.83				
CADMIUM	MG/L	0.005				
CALCIUM	MG/L	253.				
CHLORIDE	MG/L	130.				
CHROMIUM	MG/L	0.08				
COBALT	MG/L	0.02				
CONDUCTANCE	UMHO/CM	6520.				
COPPER	MG/L	0.01				
FLUORIDE	MG/L	0.95				
GROSS ALPHA	PCI/L	-				
GROSS BETA	PCI/L	-				
IRON	MG/L	0.08				
LEAD	MG/L	0.02				
MAGNESIUM	MG/L	114.				
MANGANESE	MG/L	0.17				
MERCURY	MG/L	< 0.0002				
MOLYBDENUM	MG/L	0.13				
NICKEL	MG/L	0.05				
NITRATE	MG/L	56.				
NITRITE	MG/L	-				
ORG. CARBON	MG/L	-				
PH	SU	6.88				
PHOSPHATE	MG/L	0.3				
POTASSIUM	MG/L	7.24				
RA-226	PCI/L	-				
RA-228	PCI/L	-				
SELENIUM	MG/L	0.134				
SILICA	MG/L	9.2				
SILVER	MG/L	-				
SODIUM	MG/L	1910.				
STRONTIUM	MG/L	9.55				
SULFATE	MG/L	4200.				
SULFIDE	MG/L	< 0.1				
TEMPERATURE	C - DEGREE	17.5				
TIN	MG/L	-				
TOTAL SOLIDS	MG/L	6920.				
URANIUM	MG/L	0.0390				
VANADIUM	MG/L	0.04				
ZINC	MG/L	0.006				

Table D.5.15 Chemical analyses of groundwater, Green River, Utah, tailings site (Continued)

FORMATION OF COMPLETION: CONGLOMERATE
HYDRAULIC FLOW RELATIONSHIP: ON-SITE

		LOCATION ID - SAMPLE ID AND LOG DATE									
		581-01 09/11/86		581-01 03/13/87		581-01 10/05/87		581-01 01/12/88		581-01 05/11/88	
PARAMETER	UNIT OF MEASURE	PARAMETER VALUE	+/-UNCERTAINTY	PARAMETER VALUE	+/-UNCERTAINTY	PARAMETER VALUE	+/-UNCERTAINTY	PARAMETER VALUE	+/-UNCERTAINTY	PARAMETER VALUE	+/-UNCERTAINTY
ALKALINITY	MG/L CACO3	1021.		1012.		973.		961.		979.	
ALUMINUM	MG/L	0.3		0.2		< 0.1		0.09		0.04	
AMMONIUM	MG/L	2.4		0.8		0.6		0.5		0.8	
ANTIMONY	MG/L	< 0.003		-		-		-		-	
ARSENIC	MG/L	< 0.01		-		< 0.01		0.03		0.019	
BALANCE	%	-0.21		-		-		-		-	
BARIUM	MG/L	0.1		-		-		-		< 0.01	
BORON	MG/L	0.9		0.7		0.8		0.83		0.86	
CADMIUM	MG/L	< 0.001		-		-		-		0.005	
CALCIUM	MG/L	29.5		20.5		18.1		20.0		22.1	
CHLORIDE	MG/L	100.		95.1		229.		130.		180.	
CHROMIUM	MG/L	0.01		0.01		< 0.01		0.02		0.01	
COBALT	MG/L	< 0.05		-		-		-		< 0.01	
CONDUCTANCE	UMHO/CM	5000.		4100.		5500.		4900.		4920.	
COPPER	MG/L	< 0.02		-		-		-		< 0.01	
FLUORIDE	MG/L	1.3		1.2		1.2		1.13		1.12	
GROSS ALPHA	PCI/L	-		-		0.0	32.	7.	21.	-	
GROSS BETA	PCI/L	-		-		9.9	31.	12.	16.	-	
IRON	MG/L	0.05		0.04		< 0.03		0.12		< 0.01	
LEAD	MG/L	< 0.01		-		-		-		0.09	
MAGNESIUM	MG/L	10.3		9.51		9.3		9.71		8.83	
MANGANESE	MG/L	0.02		0.03		< 0.01		0.01		0.01	
MERCURY	MG/L	< 0.0002		-		-		-		0.0027	
MOLYBDENUM	MG/L	0.09		< 0.1		< 0.01		< 0.01		0.02	
NICKEL	MG/L	< 0.04		-		-		-		< 0.01	
NITRATE	MG/L	4.2		0.4		< 1.0		< 0.1		< 0.1	
NITRITE	MG/L	< 0.1		-		-		-		-	
ORG. CARBON	MG/L	120.		-		5.		218.		-	
PB-210	PCI/L	0.5	1.3	-		-		-		-	
PH	SU	7.91		7.77		7.7		7.8		7.75	
PHOSPHATE	MG/L	< 0.1		-		-		-		0.6	
PO-210	PCI/L	0.0	0.5	-		-		-		-	
POTASSIUM	MG/L	3.86		1.88		2.26		2.25		2.51	
RA-226	PCI/L	1.2	0.5	-		0.7	0.2	0.3	0.1	-	
RA-228	PCI/L	0.2	1.4	-		2.7	0.9	0.3	0.8	-	
SELENIUM	MG/L	0.124		< 0.002		< 0.005		0.157		0.095	
SILICA	MG/L	8.		-		-		-		8.8	
SILVER	MG/L	< 0.01		-		-		-		-	
SODIUM	MG/L	1680.		1540.		1570.		1610.		1680.	
STRONTIUM	MG/L	2.5		-		-		-		2.60	
SULFATE	MG/L	2520.		2380.		2390.		2570.		2460.	
SULFIDE	MG/L	-		-		-		-		45.4	
TEMPERATURE	C - DEGREE	17.		16.5		16.0		15.0		[illegible]	
TH-230	PCI/L	8.4	1.7	-		-		-		-	
TIN	MG/L	< 0.005		-		-		-		-	
TOTAL S[illegible]S	MG/L	4770.		47900.		4520.		4630.		4630.	

Table D.5.15 Chemical analyses of groundwater, Green River, Utah, tailings site (Continued)

FORMATION OF COMPLETION: CONGLOMERATE
HYDRAULIC FLOW RELATIONSHIP: ON-SITE

		LOCATION ID - SAMPLE ID AND LOG DATE				
		581-01 09/11/86	581-01 03/13/87	581-01 10/05/87	581-01 01/12/88	581-01 05/11/88
PARAMETER	UNIT OF MEASURE	PARAMETER VALUE+/-UNCERTAINTY	PARAMETER VALUE+/-UNCERTAINTY	PARAMETER VALUE+/-UNCERTAINTY	PARAMETER VALUE+/-UNCERTAINTY	PARAMETER VALUE+/-UNCERTAINTY
URANIUM	MG/L	< 0.0003	< 0.0003	< 0.003	0.0010	< 0.0003
VANADIUM	MG/L	0.22	-	< 0.01	< 0.01	< 0.01
ZINC	MG/L	0.010	-	0.007	0.006	0.017

MAPPER DATA FILE NAME: GRN01*UDPGW0102187

Table D.5.15 Chemical analyses of groundwater, Green River, Utah, tailings site (Continued)

FORMATION OF COMPLETION: CONGLOMERATE
HYDRAULIC FLOW RELATIONSHIP: CROSS GRADIENT

		LOCATION ID - SAMPLE ID AND LOG DATE						
		561-01 06/04/86	561-01 09/07/86	561-01 02/27/87	561-01 10/01/87		561-01 01/10/88	
PARAMETER	UNIT OF MEASURE	PARAMETER VALUE+/-UNCERTAINTY	PARAMETER VALUE+/-UNCERTAINTY	PARAMETER VALUE+/-UNCERTAINTY	PARAMETER VALUE+/-UNCERTAINTY		PARAMETER VALUE+/-UNCERTAINTY	
ALKALINITY	MG/L CACO3	745.	707.	790.	606.		606.	
ALUMINUM	MG/L	13.1	5.3	0.8	< 0.1		0.7	
AMMONIUM	MG/L	1.2	0.8	0.6	0.2		0.7	
ANTIMONY	MG/L	< 0.003	< 0.003	-	-		-	
ARSENIC	MG/L	< 0.01	< 0.01	-	0.02		0.01	
BALANCE	%	-3.92	1.05	-	-		-	
BARIUM	MG/L	0.4	0.3	-	-		-	
BORON	MG/L	0.4	0.9	0.76	0.7		0.71	
CADMIUM	MG/L	< 0.001	< 0.001	-	-		-	
CALCIUM	MG/L	101.	19.6	4.94	4.1		4.40	
CHLORIDE	MG/L	190.	430.	198.	226.		210.	
CHROMIUM	MG/L	0.04	0.04	< 0.01	< 0.01		0.02	
COBALT	MG/L	0.09	< 0.05	-	-		-	
CONDUCTANCE	UMHO/CM	2200.	2200.	1925.	2310.		2330.	
COPPER	MG/L	0.04	< 0.02	-	-		-	
FLUORIDE	MG/L	2.9	3.2	2.92	2.7		2.87	
GROSS ALPHA	PCI/L	-	-	-	0.0	13.	0.	11.
GROSS BETA	PCI/L	-	-	-	2.9	12.	0.	11.
IRON	MG/L	9.53	2.13	0.16	< 0.03		0.32	
LEAD	MG/L	< 0.01	< 0.01	-	-		-	
MAGNESIUM	MG/L	12.2	3.01	1.32	0.90		1.03	
MANGANESE	MG/L	0.87	0.12	0.02	< 0.01		< 0.01	
MERCURY	MG/L	< 0.0002	< 0.0002	-	-		-	
MOLYBDENUM	MG/L	0.13	0.15	< 0.1	< 0.01		< 0.01	
NICKEL	MG/L	0.08	< 0.04	-	-		-	
NITRATE	MG/L	0.3	< 1.	< 0.1	< 1.0		< 0.1	
NITRITE	MG/L	< 0.1	< 0.1	-	-		-	
ORG. CARBON	MG/L	-	-	-	5.		136.	
PH	SU	8.16	8.23	8.44	8.15		8.5	
PHOSPHATE	MG/L	0.1	< 0.1	-	-		-	
POTASSIUM	MG/L	5.93	2.40	1.60	0.92		1.41	
RA-226	PCI/L	-	-	-	0.1	0.1	0.1	0.1
RA-228	PCI/L	-	-	-	2.2	0.9	0.3	0.8
SELENIUM	MG/L	< 0.005	< 0.005	0.11	< 0.005		0.051	
SILICA	MG/L	4.	4.	-	-		-	
SILVER	MG/L	< 0.01	< 0.01	-	-		-	
SODIUM	MG/L	556.	840.	723.	680.		666.	
STRONTIUM	MG/L	0.5	0.2	-	-		-	
SULFATE	MG/L	700.	481.	670.	650.		648.	
TEMPERATURE	C - DEGREE	19.	19.5	17.0	17.0		15.5	
TIN	MG/L	< 0.005	< 0.005	-	-		-	
TOTAL SOLIDS	MG/L	1910.	1890.	2120.	1870.		1900.	
URANIUM	MG/L	0.0008	< 0.0003	0.0028	< 0.003		< [illegible]03	
VANADIUM	MG/L	0.1	0.18	-	< 0.01		< [illegible]	
ZINC	MG/L	0.062	0.020	-	0.005		[illegible]13	

Table D.5.15 Chemical analyses of ground[illegible]r, Green River, Utah, tailings site (Continued)

FORMATION OF COMPLETION: CONGLOMERATE
HYDRAULIC FLOW RELATIONSHIP: DOWN GRADIENT

		LOCATION ID - SAMPLE ID AND LOG DATE									
		815-01 10/26/87		815-01 01/05/88		815-01 07/16/88		815-02 07/16/88		815-03 07/16/88	
PARAMETER	UNIT OF MEASURE	PARAMETER VALUE+/-UNCERTAINTY		PARAMETER VALUE+/-UNCERTAINTY		PARAMETER VALUE+/-UNCERTAINTY		PARAMETER VALUE+/-UNCERTAINTY		PARAMETER VALUE+/-UNCERTAINTY	
ALKALINITY	MG/L CACO3	427.		546.		432.		432.		432.	
ALUMINUM	MG/L	< 0.1		< 0.1		< 0.01		< 0.01		< 0.01	
AMMONIUM	MG/L	0.3		0.3		< 0.1		< 0.1		< 0.1	
ARSENIC	MG/L	< 0.01		0.002		0.005		0.003		0.004	
BARIUM	MG/L	-		-		0.05		0.05		0.05	
BORON	MG/L	0.6		0.57		0.69		0.67		0.67	
CADMIUM	MG/L	-		-		0.002		0.003		0.003	
CALCIUM	MG/L	7.6		8.18		7.94		7.72		7.72	
CHLORIDE	MG/L	930.		950.		930.		1020.		1020.	
CHROMIUM	MG/L	< 0.01		0.03		< 0.01		< 0.01		< 0.01	
CONDUCTANCE	UMHO/CM	3850.		3760.		3650.		3650.		3650.	
COPPER	MG/L	-		-		< 0.01		< 0.01		< 0.01	
FLUORIDE	MG/L	3.2		3.21		3.3		3.3		3.3	
GROSS ALPHA	PCI/L	0.0	37.	4.	16.	0.	29.	9.	16.	0.	21.
GROSS BETA	PCI/L	0.0	28.	16.	19.	2.	19.	14.	9.	7.	11.
IRON	MG/L	< 0.03		0.14		< 0.01		< 0.01		< 0.01	
LEAD	MG/L	-		-		0.02		< 0.01		0.01	
MAGNESIUM	MG/L	2.71		2.64		2.55		72.9		2.48	
MANGANESE	MG/L	< 0.01		< 0.01		< 0.01		< 0.01		< 0.01	
MERCURY	MG/L	-		-		< 0.0002		< 0.0002		< 0.0002	
MOLYBDENUM	MG/L	0.01		0.05		0.03		0.03		0.03	
NITRATE	MG/L	1.0		< 0.1		12.		11.		11.	
ORG. CARBON	MG/L	10.		113.		113.		110.		113.	
PH	SU	8.15		8.20		8.27		8.27		8.27	
POTASSIUM	MG/L	1.43		1.55		1.5		1.5		1.7	
RA-226	PCI/L	0.3	0.2	0.1	0.2	0.1	0.2	0.1	0.2	0.1	0.2
RA-228	PCI/L	0.0	1.2	0.	0.8	0.1	0.8	0.2	0.8	0.0	0.7
SELENIUM	MG/L	< 0.005		0.027		0.024		0.039		0.034	
SILVER	MG/L	-		-		< 0.01		< 0.01		< 0.01	
SODIUM	MG/L	960.		1070.		1050.		1050.		1040.	
SULFATE	MG/L	480.		572.		529.		553.		548.	
SULFIDE	MG/L	-		-		< 0.1		< 0.1		< 0.1	
TEMPERATURE	C - DEGREE	15.5		14.4		16.0		16.0		16.0	
TOTAL SOLIDS	MG/L	2860.		2930.		2800.		2830.		2850.	
URANIUM	MG/L	< 0.003		< 0.003		< 0.0003		< 0.0003		< 0.0003	
VANADIUM	MG/L	< 0.01		< 0.01		< 0.01		< 0.01		< 0.01	
ZINC	MG/L	0.012		0.009		< 0.005		< 0.005		< 0.005	

Table D.5.15 Chemical analyses of groundwater, Green River, Utah, tailings site (Continued)

FORMATION OF COMPLETION: CONGLOMERATE
HYDRAULIC FLOW RELATIONSHIP: DOWN GRADIENT

		LOCATION ID - SAMPLE ID AND LOG DATE						
		815-04 07/16/88		815-05 07/16/88				
PARAMETER	UNIT OF MEASURE	PARAMETER VALUE+/-UNCERTAINTY		PARAMETER VALUE+/-UNCERTAINTY		PARAMETER VALUE+/-UNCERTAINTY	PARAMETER VALUE+/-UNCERTAINTY	PARAMETER VALUE+/-UNCERTAINTY
ALKALINITY	MG/L CACO3	432.		432.				
ALUMINUM	MG/L	< 0.01		< 0.01				
AMMONIUM	MG/L	< 0.1		< 0.1				
ARSENIC	MG/L	0.004		0.003				
BARIUM	MG/L	0.05		0.05				
BORON	MG/L	0.67		0.67				
CADMIUM	MG/L	0.002		0.003				
CALCIUM	MG/L	7.70		7.71				
CHLORIDE	MG/L	960.		960.				
CHROMIUM	MG/L	< 0.01		< 0.01				
CONDUCTANCE	UMHO/CM	3650.		3650.				
COPPER	MG/L	< 0.01		< 0.01				
FLUORIDE	MG/L	3.3		3.3				
GROSS ALPHA	PCI/L	0.	19.	0.	24.			
GROSS BETA	PCI/L	0.	10.	0.	12.			
IRON	MG/L	< 0.01		< 0.01				
LEAD	MG/L	< 0.01		< 0.01				
MAGNESIUM	MG/L	2.46		2.46				
MANGANESE	MG/L	< 0.01		< 0.01				
MERCURY	MG/L	< 0.0002		< 0.0002				
MOLYBDENUM	MG/L	0.03		0.03				
NITRATE	MG/L	11.		12.				
ORG. CARBON	MG/L	111.		110.				
PH	SU	8.27		8.27				
POTASSIUM	MG/L	1.7		1.7				
RA-226	PCI/L	0.1	0.2	0.1	0.1			
RA-228	PCI/L	0.3	0.7	0.3	0.7			
SELENIUM	MG/L	0.031		0.029				
SILVER	MG/L	< 0.01		< 0.01				
SODIUM	MG/L	1030.		1050.				
SULFATE	MG/L	548.		556.				
SULFIDE	MG/L	< 0.1		< 0.1				
TEMPERATURE	C - DEGREE	16.0		16.0				
TOTAL SOLIDS	MG/L	2820.		2840.				
URANIUM	MG/L	< 0.0003		< 0.0003				
VANADIUM	MG/L	0.01		0.02				
ZINC	MG/L	< 0.005		0.005				

MAPPER DATA FILE NAME: GRN01*UDPGW0402188

Table D.5.15 Chemical analyses of groundw...er, Green River, Utah, tailings site (Continued)

FORMATION OF COMPLETION: SANDSTONE
HYDRAULIC FLOW RELATIONSHIP: UP GRADIENT

		LOCATION ID - SAMPLE ID AND LOG DATE									
		586-01 09/11/86		586-01 03/13/87		586-01 10/05/87		586-01 01/07/88		587-01 09/11/86	
PARAMETER	UNIT OF MEASURE	PARAMETER VALUE	+/-UNCERTAINTY	PARAMETER VALUE	+/-UNCERTAINTY	PARAMETER VALUE	+/-UNCERTAINTY	PARAMETER VALUE	+/-UNCERTAINTY	PARAMETER VALUE	+/-UNCERTAINTY
ALKALINITY	MG/L CACO3	720.		424.		569.		586.		842.	
ALUMINUM	MG/L	0.5		0.1		< 0.1		< 0.1		0.8	
AMMONIUM	MG/L	1.0		2.4		0.2		0.1		1.0	
ANTIMONY	MG/L	< 0.003		-		-		-		< 0.003	
ARSENIC	MG/L	< 0.01		-		0.01		0.03		< 0.01	
BALANCE	%	-2.79		-		-		-		-2.08	
BARIUM	MG/L	< 0.1		-		-		-		< 0.1	
BORON	MG/L	0.6		0.7		0.6		0.65		0.4	
CADMIUM	MG/L	< 0.001		-		-		-		< 0.001	
CALCIUM	MG/L	8.20		6.42		12.3		12.5		3.18	
CHLORIDE	MG/L	110.		142.		183.		180.		190.	
CHROMIUM	MG/L	0.03		0.06		< 0.01		0.07		0.04	
COBALT	MG/L	< 0.05		-		-		-		< 0.05	
CONDUCTANCE	UMHO/CM	2500.		2300.		2400.		2290.		3500.	
COPPER	MG/L	< 0.02		-		-		-		0.03	
FLUORIDE	MG/L	2.7		3.0		2.6		0.81		3.0	
GROSS ALPHA	PCI/L	-		1.	11.	0.0	20.	2.5	8.7	-	
GROSS BETA	PCI/L	-		4.5	5.7	0.0	14.	9.	10.	-	
IRON	MG/L	0.07		< 0.03		< 0.03		0.34		0.04	
LEAD	MG/L	0.01		-		-		-		0.01	
MAGNESIUM	MG/L	3.48		2.20		4.5		3.45		0.011	
MANGANESE	MG/L	0.03		0.02		< 0.01		< 0.01		0.03	
MERCURY	MG/L	< 0.0002		-		-		-		< 0.0002	
MOLYBDENUM	MG/L	0.14		< 0.1		< 0.01		0.02		0.09	
NICKEL	MG/L	< 0.04		-		-		-		< 0.04	
NITRATE	MG/L	2.		0.4		< 1.0		< 0.1		< 1.	
NITRITE	MG/L	< 0.1		-		-		-		< 0.1	
ORG. CARBON	MG/L	-		-		6.		117.		-	
PH	SU	9.92		10.51		8.1		8.05		11.49	
PHOSPHATE	MG/L	< 0.1		-		-		-		< 0.1	
POTASSIUM	MG/L	8.20		2.46		1.34		1.34		17.1	
RA-226	PCI/L	-		0.1	0.2	0.1	0.1	0.	0.1	-	
RA-228	PCI/L	-		-		1.2	0.8	0.3	0.8	-	
SELENIUM	MG/L	0.036		< 0.002		< 0.005		0.021		0.106	
SILICA	MG/L	10.		-		-		-		13.	
SILVER	MG/L	< 0.01		-		-		-		< 0.01	
SODIUM	MG/L	680.		643.		640.		682.		730.	
STRONTIUM	MG/L	0.2		-		-		-		0.1	
SULFATE	MG/L	699.		720.		690.		702.		546.	
SULFIDE	MG/L	-		-		-		-		-	
TEMPERATURE	C - DEGREE	16.		16.5		17.0		16.0		17.	
TH-230	PCI/L	-		0.0	0.4	-		-		-	
TIN	MG/L	< 0.005		-		-		-		< 0.005	
TOTAL SOLIDS	MG/L	1920.		1920.		1830.		1870.		1990.	
URANIUM	MG/L	0.0049		0.0036		< 0.003		0.0012		< 0.0003	
VANADIUM	MG/L	0.19		-		< 0.01		< 0.01		0.22	

Table D.5.15 Chemical analyses of groundwater, Green River, Utah, tailings site (Continued)

FORMATION OF COMPLETION: SANDSTONE
HYDRAULIC FLOW RELATIONSHIP: UP GRADIENT

		LOCATION ID - SAMPLE ID AND LOG DATE				
		586-01 09/11/86	586-01 03/13/87	586-01 10/05/87	586-01 01/07/88	587-01 09/11/86
PARAMETER	UNIT OF MEASURE	PARAMETER VALUE+/-UNCERTAINTY	PARAMETER VALUE+/-UNCERTAINTY	PARAMETER VALUE+/-UNCERTAINTY	PARAMETER VALUE+/-UNCERTAINTY	PARAMETER VALUE+/-UNCERTAINTY
ZINC	MG/L	0.015	-	0.007	0.012	< 0.005